SWIMMING BEHAVIOR OF THE HUMAN INFANT

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THE swimming behavior of the human infant bears striking testimony to the phylogenesis of man. Literature on the subject is sparse, limited largely to comments on the random movements of the newborn infant having a swimminglike quality. The only instances of actual experimental evidence cited are those of Watson[1] and the writer.[2] Watson's observations were on the behavior of three infants tested immediately after birth, as soon as breathing had been well established. His method was to support the baby's back with his hands and gradually lower him in a supine position into the water, maintained at body temperature, so that the body was immersed, but the face was above the water level, thereby preventing water from entering the respiratory passages. Watson report, "Violent expression of fear—a cry, checking of breathing, followed by deeper inspiration and rapid, entirely uncoordinated, slashing of hands and feet were all that could be observed." On the basis of these observations Watson discounts any evidence of swimming movements in the newborn behavior repertoire.

The present report comprises a more intensive study of the data which formed the basis of the descriptive analysis reported in "Growth."[2] Descriptive notes and cinema records were accumulated on 42 different infants, ranging in age from 11 days to 2½ years. Observations of the same infants were repeated at different intervals, the total number of observations on the 42 babies being 445. Of this total, 164 consisted of motion picture records, and 281 were in the nature of written notes. The number of repeated observations on the same child varied from 2 to 51, the median being 10. Although in several cases these repeated observations extended over a period of 18 or 20 months, the data were insufficient to justify longitudinal analysis. On the other hand the fact that the same children were tested at different intervals over a period of time indicates, more convincingly than purely cross-sectional observations would, that the changes in this behavior pattern have developmental import.

At each examination the baby was placed in three different positions: (1) With the hands of the experimenter placed under his chin and on the crown of his head, he was supported in the water in such a way that his body and extremities could move freely while his nose and mouth were protected above the water level; (2) he was submerged in a prone

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position without any support whatsoever; and (3) he was submerged without support in a supine position. The movements in each position were observed and described especially with respect to their organization, rhythmicity, and perseveration.

The movements of the infant only a few weeks old are striking when he is placed in water in a prone position. The baby usually remains in the prone position. Definite rhythmical associated flexor-extensor movements in upper and lower extremities together with a lateral flexion of the trunk corresponding to the flexor phase of the lower extremity are usually manifested. These movements are ordinarily sufficiently forceful to propel the baby a short distance through the water. The character of the movements is essentially the same whether the baby is supported under the chin or submerged in a prone position. Definite organization and rhythmicity of movements are, however, more pronounced when the infant is submerged. While similar to the reflex crawling and stepping movements which involve frictional hindrance, these swimming movements of the newborn infant are distinctly more synchronous and rhythmical. Even when the same infant is suspended in a prone position in air, and there is no friction with a hard underlying surface, his movements are not so rhythmical or organized as they are in water. Another outstanding feature of the infant's behavior during the newborn phase is breath control. Apparently a reflex inhibits his breathing while he is submerged, since he does not cough or show disturbances common among the older babies after they have been submerged. In fact, there seems to be a summation effect of the two reflex mechanisms since the neuromuscular activity is better integrated when respiration is inhibited, as indicated in the submerged situation. For the simple reason that the young baby remains in a prone position and engages in these rhythmical movements with sufficient force to propel his body forward through the water the term "reflex swimming movements" seems suitable to indicate this period. These rhythmical movements of the human infant are quite similar to those of other young quadrupeds in water.*

After the baby is 4 months of age or older, the rhythmicity and pattern of the early behavior become disorganized. Often the babies are quite inactive when supported under the chin, and when submerged prone they usually rotate into a dorsal position, and the movements of the extremities are of the struggling order. They clutch at the experi-

*For comparison we have studied the swimming behavior of the following mammals: (1) pouch young opossum ranging in length from 10 to 165 millimeters; (2) newborn rat, (3) kitten, (4) rabbit, (5) guinea pig, (6) *macacus rhesus* monkeys ages 5, 6, 15, and 340 days, and (7) one 2-month-old chimpanzee. All maintained the prone position and engaged in rhythmical movements of upper and lower extremities with the exception of the 2-month-old chimpanzee which was immobile and sank to the bottom, and the 15-day-old monkey, which maintained a vertical position in the water and whose movements were less organized and rhythmical than those of the younger monkeys. These observations suggest that the primitive reflex was beginning to disintegrate in this monkey by the time he was 2 weeks old. Observations should be made on a newborn chimpanzee before inference can be drawn as to the developmental status represented by the animal observed. This occasion is taken to express gratitude to Dr. Margaret A. Kennard for the privilege of photographing the primate behavior.

menter's hand, try to wipe the water from the face, or they may sink deeper into the water without marked manifestations of motor activity. Both the struggling activity and the comparative inertia are, for the sake of convenience, classed as representing the disorganized phase of development in this type of behavior. This phase, i.e., the struggling type of movement and the tendency to rotate from a prone to a dorsal position, continues as the most characteristic mode of behavior until about the time the baby is capable of independent erect locomotion. It was apparent during this phase that the baby had more noticeable difficulty with respiration, or controlling respiration, when he was submerged. Often the ingestion of fluid was considerable, and the infant would cough or otherwise show respiratory disturbance when he was taken out of the water.

Toward the beginning of the second year the child again shows a tendency to remain in the prone position, to engage in flexor-extensor movements of the extremities, especially the lower extremities, and to propel his body through the water. The quality of these movements is distinctly different from the rhythmical movements of the newborn; they are more deliberate and apparently of voluntary order. The child is not merely fighting; he is making purposeful movements, fairly well organized, but less automatic than the reflex movements, in order to gain the edge of the pool. At no time did any baby show himself capable of raising his head above the water level for the purpose of breathing.

In the dorsal position, with few exceptions, the disorganized or struggling movements were characteristic throughout the age range, and so the movements made when the child is submerged in the supine position do not show outstanding developmental changes. Although the baby engages in struggling movements, he does not rotate from a supine to a prone position. This observation on movements of the baby in a dorsal position probably explains why Watson found only "uncoordinated slashing of the hands and feet" in the aquatic behavior of the newborn.

The characteristic pattern of the newborn swimming movements is illustrated in the line drawings of Fig. 1 *A*. These drawings were obtained by tracing sequential projections of moving picture film in order to illustrate synergic movements. Fig. 1 *B* shows similar tracings representing the disorganized phase of the behavior pattern. It will be noticed in these drawings that the baby tends to rotate into a dorsal position and that there is no definite consistency or pattern in the consecutive movements. Fig. 1 *C* illustrates the deliberate movements of the ambulatory child. The impression gained from our observations of the children around this age is that without sustained swimming experience these movements subsequently become disorganized and the older child must learn to maintain the prone position for swimming. Sometimes these children, after making a few strokes in the prone position, would tend to assume a vertical position. Most children of 5 or 6 years whom

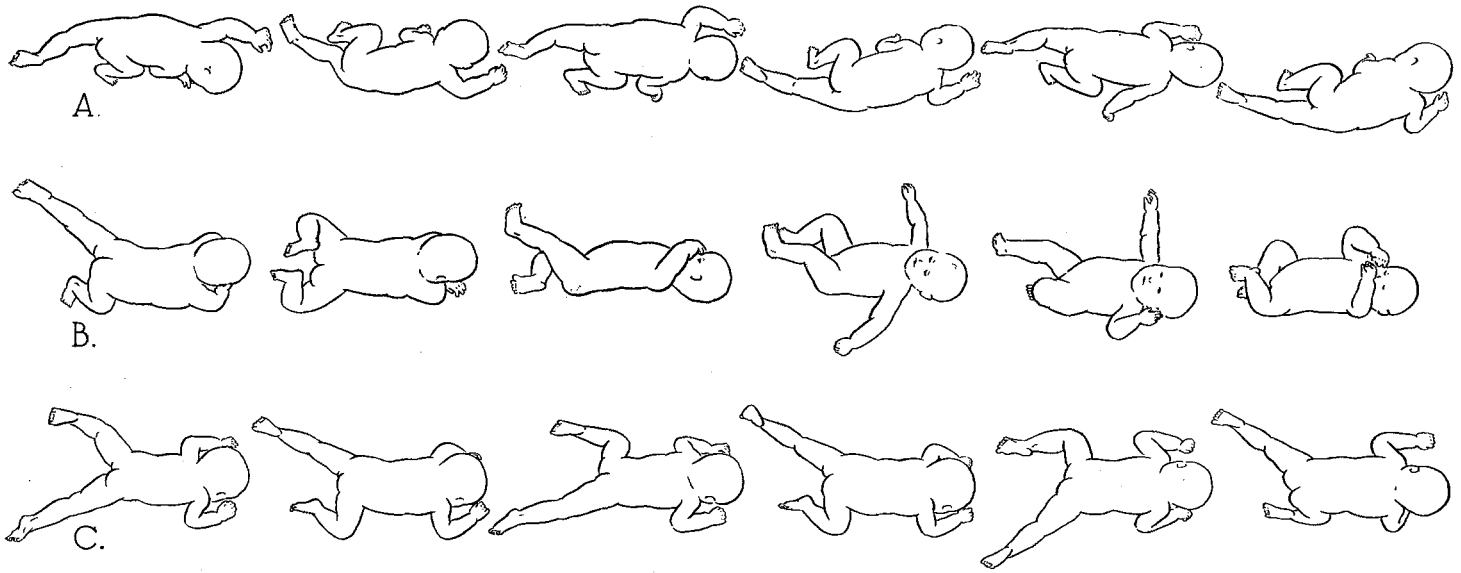

Fig. 1.—Line drawings representing three phases in the development of aquatic behavior of the human infant.

A. Reflex swimming movements.

C. Voluntary or deliberate movements.

B. Disorganized behavior.

These drawings were obtained by tracing successive frames of 16 mm. movie film illustrating the quality of consecutive movements made at different chronological or developmental stages.

the writer has had occasion to observe when they were learning to swim have shown a tendency to maintain an upright rather than a prone position in the water. This vertical position is probably an adaptive response for the purpose of getting the head above the water level. Apparently the ability to maintain the prone position in water is a definite phase in the achievement of swimming, and it is a characteristic, together with the quality of limb movements, which critically differentiates developmental phases in the growing infant.

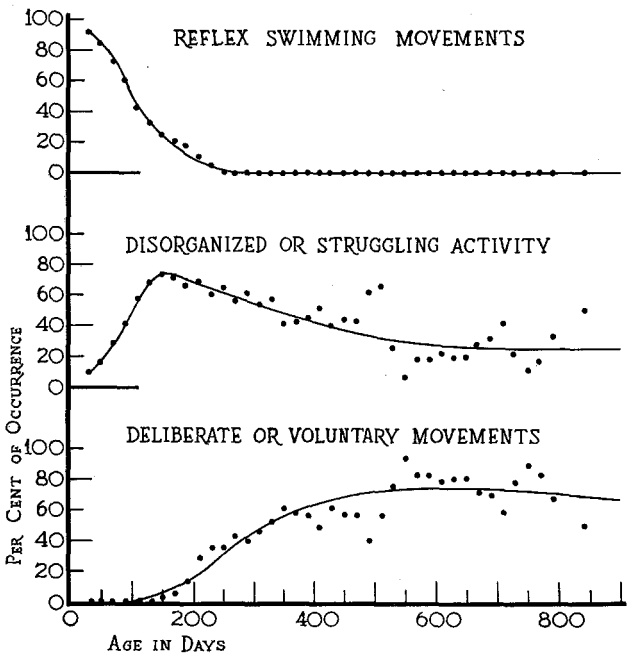

Fig. 2.—The incidence of three phases in the aquatic behavior of infants.

In order to show the general trend of development in aquatic behavior, the data on these 42 infants were tabulated on a plus-minus basis in chronological periods of 20 days. The results are indicated in the three curves (Fig. 2), showing (a) the decline of the reflex phase, (b) the period when disorganized behavior is most prominent, and (c) finally the period when the more deliberate movements are manifested. Since these curves represent group data, the phases are not so well differentiated as is the case when successive examinations of individual children are similarly analyzed. The scatter is the resultant of the fact that individual children vary considerably as to the inception and decline of different phases in the development of any activity. However, despite the scatter the decline of the reflex phase in this activity corresponds closely to the declining period of other atavistic reflexes, such as the Moro reflex, suspension grasp, crawling and stepping movements in the young infant.

INTERPRETATION

This study covers an analysis of the neuromuscular movements of infants when submerged in water. The manifestation in the newborn infant of a rhythmical, coordinated, reflex movement simulating the aquatic movements of other newborn mammals suggests functional evidence of the phylogenesis of man. The maturation of the central nervous system is reflected in the sequential changes of aquatic behavior as well as in other types of neuromuscular activity common to the human infant. It is interesting that developmental changes in swimming behavior correspond in chronological order to the major phases of other behavior patterns which also appear to be of phylogenetic origin.

REFERENCES

1. Watson, John: Psychology from the Standpoint of the Behaviorist, Philadelphia, 1919, J. B. Lippincott Company, p. 243.
2. McGraw, Myrtle B.: Growth, A Study of Johnny and Jimmy, New York, 1935, D. Appleton-Century Company, pp. 122-136.