human infancy; a uniqueness which makes itself manifest very early. At no phase of the entire life cycle are infant and simian the same. The human characteristics are not added as an installment upon a lower primitive stage; but they inhere in the beginnings of the infant's behavior.

The preëminence of human infancy lies in the prolongation and deepening of plasticity. There is specific maturation of behavior patterns as in subhuman creatures; but this proceeds less rigidly and the total behavior complex is suspended in a state of greater formativeness. This increased modifiability is extremely sensitive to the social milieu and is constantly transforming the context of adaptive behavior. In the impersonal aspects of adaptive behavior of the nonlanguage type (general practical intelligence) there is a high degree of early correspondence between man and other primates. This correspondence may prove to be so consistent in some of its elements as to suggest evolutionary and even recapitulatory explanations.

But transcending, pervading, and dynamically altering that strand of similarity is a generalized conditionability and a responsiveness to other personalities, to which man is special heir. This preëminent sociality exists even through the prelanguage period, long before the child has framed a single word. Herein lies his humanity. This humanity does not wait for upright posture and speech. It is present at birth. It came, to be sure, late in the history of the race, but it arrives early in the history of the individual.

CHAPTER XVII

GROWTH POTENCY AND INFANT PERSONALITY

The Problem of Heredity in Relation to Mental Growth

There are two sharply contrasted doctrines of development. One emphasizes heredity and the powerlessness of environment. The other exalts environment and makes it the architect of the growing organism. The former doctrine traces the make-up of the individual to all determining unit characters or genes. Even complex psychological characteristics are attributed to these original packets of chromosomal material. The alternative doctrine suggests that even physical characteristics are molded by the conditions of development; and that mental characteristics, including capacity, talent and temperament are ultimately the result of training and conditioning.

Such contrasts in developmental doctrine are to be found not only in theoretical discussions but in the literature of education and reform. When Robert Owen founded the first nursery school in America just a century ago he was moved by an ardent faith in environment. At the National Capitol before the President, the Congress, and the Supreme Court, he stated his faith in these words:

"External circumstances may be so formed as to have an overwhelming and irresistible influence over every infant that comes into existence, either for good or evil; to compel him to receive any particular sentiments or habits, to surround

him through life, with the most agreeable or disagreeable objects, and thus at pleasure make any portion, or the whole of the human race, poor, ignorant, vicious and wretched; or affluent, intelligent, virtuous and happy."

I. THE INTERDEPENDENCE OF HEREDITY AND ENVIRONMENT

Where does the truth lie? Probably not at either extreme. The opposition of doctrines of development has led to an overrigid distinction between intrinsic and extrinsic factors. Proverbs, metaphors, and epigrams have conspired to widen the cleavage between nature versus nurture, instinct versus habit, inheritance versus training, original versus acquired capacity. We have so overconventionalized the concepts of heredity and environment even in scientific textbooks that these concepts have become antithetical when they are in fact supplementary and reciprocal. In the field of mental inheritance there are further sources of confusion. The geneticist tends to speak of mental traits as though they were discrete faculties and lumps them with physical unit characters. The psychologist on the other hand is prone to argue in terms of a discrete, hormic mind independent of the bodily structure.

Here again the concept of growth proves its value. It leads to a depolarization of the two opposing categories of heredity and environment. Growth always represents a continuum; it therefore becomes unnecessary to draw a sharp distinction between physical and mental manifestations. Growth is also a process of integrative organization; it thus becomes desirable to consider *conjointly* the factors which enter into the shaping of the individual. From this point of view the organic mechanism of development and the reciprocal rather than the contrastive influence of

heredity and environment is of chief concern. The interest shifts to the *conditions* of development, and to the projective influence of one stage of development upon another stage. Growth is constantly creating its own conditions. It is important not only to recognize the germinal determinations which underlie the growth process, but the regulatory influence of the very products of growth.

The supreme genetic law appears to be this: All present growth hinges on past growth. Growth is not a simple function neatly determined by X units of inheritance plus Y units of environment, but is an historical complex which reflects at every stage the past which it incorporates. In other words we are led astray by an artificial dualism of heredity and environment, if it blinds us to the fact that growth is a continuous self-conditioning process, rather than a drama controlled, *ex machina*, by two forces.

It follows from these considerations that it is impossible to determine in any precise way the exact degree of hereditary versus environmental influence in early mental development. At the present stage of knowledge it is important to avoid any over simplification of the problem. Bearing these difficulties and reservations in mind, we may, however, presently examine the drift of our available data, and venture some suggestions as to the relative rôle of inherent and induced factors in the mental growth of the infant. It will be understood that the so-called inherent factors may from a strict biological point of view often have a secondary or derived aspect. For example, the genesis of the eye in the embryo is due to an inherent, specific organ-forming substance in the genes. This is a primary chemical differentiation; but even this self-differentiation is under the influence of an organizing center and of gradients from which influences spread. The early development of the organ is furthermore regulated by

its position in relation to other organs. This is a form of dependent differentiation, in which mechanical and physical influences come into play. After the attainment of histological differentiation of the tissues, the organism begins to function as a more or less integrated individual. From then on four new processes come into operation — "the trophic influence of nerves; the circulation of growth-modifying internal secretions; differential growth along different axes; and the adaptational effect of function."

Although these refinements belong to the field of experimental biology and cannot enter into a discussion of mental inheritance, they should at least figure in the background of such discussion, as a corrective against uncritical generalization and "inspired thinking."[1] It is apparent that biometry, although it must supply the measurements and statistics of individual differences, cannot elucidate the actual mechanism of individual differentiation. This is a problem of physiology, and the pioneer investigations of developmental physiology are already putting the traditional question of Nature vs. Nurture in a new light. The genes initiate the process of development and determine its sphere and limits; but the process continuously creates its own inner control.

2. EXPERIMENTAL STUDIES OF MATURATION

One approach upon the problem of the development of behavior lies in the study of maturation. The phenomena of maturation in relation to function and experience furnish

[1] The reader may be referred particularly to H. S. Jennings: *Prometheus, or Biology and the Advancement of Man.* Dutton & Co., New York, 1925, 86 pp.; and to Julian Huxley's "The Tadpole: A Study in Developmental Physiology," the concluding chapter of his essays in *Popular Science.* Alfred A. Knopf, New York, 1927, 316 pp. See also Frank R. Lillie, "The Gene and the Ontogenetic Process" in *Science,* October 21, 1927; vol. 66, pp. 361–369. An extended bibliography will be found in Thomas Hunt Morgan's *Experimental Embryology,* New York, 1927. Columbia University Press, p. 766.

some hint as to the potency of innate growth factors. By maturation is meant the inherent progressive alteration which tends to bring a growing organism to a state of completeness. It is a more restrictive term than growth and is intended to designate those changes which are primarily dependent upon nutrition and duration, rather than extraneous factors.

An ingenious experimental study of the problem of maturation was made by Carmichael.[1] He removed a group of frogs and salamanders from the influence of external stimulation during their early development. His method was as follows: The embryos were divided into two groups, a control group, which were permitted to develop naturally in tap water; a narcotized group which were drugged with chloretone solution in their early head and tail-bud stages. The drugged embryos remained motionless, even to tactile stimulation of the body skin. They did not swim at their appointed time because of their anesthesia. The control embryos, however, reacted to touch, and duly displayed their natural swimming movements.

The drugged embryos were then denarcotized by the simple process of transferring them to tap water. And they swam even though they had not ever swum before. In fact some of the salamanders promptly swam so well, "that they could with difficulty, if at all, be distinguished from the members of the control group who had been free swimmers for five days." The swimming reaction was not, however, perfect at the first trial; there was a continuous series of increasingly complex responses from an initial twitch to full coördination.

[1] Carmichael, L., "The Development of Behavior in Vertebrates Experimentally Removed from the Influence of External Stimulation," *Psychological Review,* 1926, Vol. 33, pp. 51–58.

The experimenter does not conclude from this striking result that function and experience are of minor importance in the economy of growth. On the contrary he inferred that the results "indicate the interdependent action of both heredity and environment in determining the functional development of the individual." He is in accord with Child's view that "living protoplasm is functioning at all times and development is a process of functional construction, that is beginning with a given structure and function, the continuance of function modifies the structural substratum and this in turn modifies further function and so on."

The general problem of maturation has been investigated in great detail by G. E. Coghill in his "Correlated Anatomical and Physiological Studies of the Growth of the Nervous System in Amphibia." [1] The studies were based on numerous systematic sections of the nervous system, and cell count delineations of the neurones at different levels and stages.

Coghill found that the innate maturation of the nervous system determined its primary structure, and that function or exercise did not even hasten the various types of reaction. He infers that the specificity of nervous structures in terms of behavior is "determined by laws of growth in which the behavior values of the patterns of response have no part."

But he also notes that mere maturation results in stereotyped performance, that even in such a function as swimming "the early growth of association neurones into the motor mechanism introduces unpredictable elements in behavior." This progressive, adaptive mechanization of the association

[1] Six of these studies have appeared in Volumes 24, 26, 37, 40, and 41 of *The Journal of Comparative Neurology*. The last of these deals with "The Mechanism of Integration in Amblystoma Punctatum." See also G. E. Coghill: "The Growth of Functional Neurones and its Relation to the Development of Behavior." Published in *The Proceedings of the American Philosophical Society*, Vol. 65, No. 1, 1926.

systems is equivalent neuro-embryologically to habituation and conditioning of reflexes.

Although the development of the nervous system of vertebrates does not proceed in a homogeneous manner, it appears from the beginning to maintain the integration of the individual. Separate reflexes do not grow independently to be later combined into a total unity; but "arise by a process of individuation within a primarily integrated total pattern." It is quite conceivable that the integrity of the infant as well as amblystoma is preserved in the same manner. There is no suggestion that the growing complex of infant behavior can be accounted for by a combination of smaller behavior units.

The following conclusion is of such fundamental import for the theoretical interpretation of behavior development, that it should be quoted in full from the author's monograph:[1]

"The form of the behavior pattern in Amblystoma up to and including locomotion is determined by specific neural counterparts that acquire their specificity in functional value through laws of growth in the nervous system. There is evidence also that mechanisms that condition the performance of such a behavior pattern as locomotion in mammals are determined in the same manner. It is important, therefore, to know how far growth, in the sense of the differentiation of new functional parts of cells, is projected into the life-history of the vertebrate, for so long as it continues it must participate in the function of the nervous system as a whole and, therefore, in the development of the behavior pattern."

Here we glimpse the meaning of growth as opposed to learning in the traditional and somewhat mechanical sense.

[1] P. 136, *Journal of Comparative Neurology*, Vol. 41, No. 1, August, 1926. The Wistar Institute Press, Philadelphia, Pa.

It appears that through growth, experience becomes incorporated into the maturing nervous system. Tanzi and Cajal suggested that function or exercise activated the growth of the nerve cells. Coghill holds that the nerve cells grow by their own intrinsic potentiality, and that while growing the nervous mechanisms acquire their behavior specificity.

Not the least value of this conception of the growth of neurones in relation to behavior lies in the constructive effect which it has on the nature versus nurture antithesis. Original growth potency becomes the fact of basic importance; but this potency is realized in no foreordained detail. Experience and milieu enter into the very process of growth.

3. THE INHERENT BASIS OF DEVELOPMENTAL TREND AND TEMPO

Recognizing, then, the intimate interplay of innate, induced, and environmental factors, we may inquire into the rôle of heredity in some of the major aspects of mental growth set forth in preceding chapters.

The tempo and trend of development in each infant appear to be constitutional characteristics, for the most part hereditary in nature. In cases of secondary amentia the retardation of developmental rate is, of course, acquired. The deficiency then becomes part of the constitution of the child, and the "retardation" is symptomatic of impairment of structure and reduction of developmental potency. Such potency as remains, however, is part of the original nature of the child. The reduction of potency may occur in utero, at time of birth, or postnatally. The reduction may be complete or partial, selective or symmetrical; and in any given case the developmental end-results depend chiefly upon the original deprivation rather than the later environmental opportunity. In certain injuries to the central nervous system, however, there is an indeterminate reserve of nerve-cell tissue, which can undergo substitutive or compensatory development. The effectuality of training and environment will then depend upon the age at which the damage occurred, the amount of available compensating tissue, and the intensity of the demand upon it. When these factors conspire favorably, certain "hopeless" cases of motor disability undergo remarkable improvement under the stress of effort and training. Here the rôle of environment is critical.

It is significant that for many cases of mental deficiency the cause is quite obscure. In the absence of a frank illness, injury, or trauma, the temptation is to ascribe the deficiency to germinal defect. The possibilities of defective growth regulation in the early embryonic period are however, theoretically, so numerous that many of these instances of congenital defect cannot be safely ascribed to faulty genes. The defect, however, is constitutional and the lowered tempo and lowered trend of development are as ineradicably part of the physiological equipment of the individual as the skin pattern of his hands.

The mental growth curves of the six siblings reported in Chapter VIII are strongly suggestive of underlying hereditary determination. The curves represent two highly contrastive types of growth. It is scarcely conceivable that such a consistent disparity could arise out of some subtle difference in nutrition, hygiene, or household conditions for the two groups. The children were reared in the same home by the same hand. It is more conceivable that a decisive difference in the germinal determinations account for both the average and the reduced growth potency.

Acceleration of development, likewise, is typically an

inherent biological characteristic of the individual, most probably hereditary in nature. There is no convincing evidence that fundamental acceleration of development can be readily induced by either pernicious or enlightened methods of stimulation. Through sheer conditioning and training it is possible to teach both infants and animals prodigious tricks. It is possible, also, that certain kinds of conditioning may exert a deep augmenting effect upon the dynamics of individual growth, reaching the endocrine constitution. This would be a secondary, derived kind of acceleration, comparable to the reduction of development in secondary amentia. It is a theoretical possibility rather than a frequent clinical manifestation. Abnormal forms of precocity encountered clinically are likely to be partial and unsymmetrical. They constitute atypical deviations; they may be associated with infantilism and with unusual or pathological glandular conditions. The wholesome variety of acceleration found with superior endowment, is really part and parcel of that endowment, a symptom of intensified growth, a fundamental individual difference, characteristic of, because necessary to, the developmental mechanics of certain kinds of ability. If the methods of biochemical measurement were available, it might be possible to determine certain differences in the energetics or dynamics of these rapidly growing infants, even in the first months of existence, when we could scarcely attribute their precocity to special educational or environmental stimulation.

If the superior individual as a rule mentally grows not only faster but for a longer time, this lengthened span may be regarded as primarily a manifestation of inherent endowment. That secondary, derived factors also come into play will be presently noted. The interspecies and interracial differences in the duration of plasticity are doubtless correlated with

differences in organic constitution. Within limits, comparable individual differences in the growth cycle of man may be presumed to have a similar basis.

This does not, however, exclude the operation of extrinsic influences. Whether one regards thyroid extract as an article of diet, or as a biochemical activator, it is certain that in some instances it affects the metabolism of the body so profoundly as to have a demonstrable effect upon both physical and mental growth. Here, then, an extrinsic factor modifies the tempo and trend of development. It is also possible that future insight into endocrine physiology will actually lead to a postponement and amelioration of senility. Then again the dominance of hereditary determination would give way to environmental regulation. For similar reasons it is probable that superior physical hygiene will continue to have a favorable effect upon growth, particularly in cases of previous neglect or partial deprivation. In one or two of the "atypical" growth cases reported in the foregoing section, it is possible that obscure but genuine alterations of the physiological economy were responsible for the psychodevelopmental improvement. On the whole, the stability of the developmental trend and tempo is more conspicuous than its sensitiveness to "external" influences. The case of puberty praecox described in Chapter XIII, is particularly impressive. Here adolescence was precociously displaced to the extent of a whole decade; the morphology of the body was definitely responsive to this glandular deviation; but the nervous system was only mildly deflected in its course of growth.

To what extent endocrine complexes are to be construed as genuinely hereditary is a significant genetic question. They may be in the nature of adaptations to climatic and nutritional conditions, rather than evidences of fundamental

germinal variations. Shirokogoroff[1] in his elaborate study of the process of physical growth among the Chinese holds that growth is controlled by the complex of glands of internal secretion on the one hand and the inherent peculiarities of ethnical groups on the other. The latter peculiarities are more clearly hereditary than the former. He came to the general conclusion that "The endocrine complexes define not only the process of physical growth, but the psychic behavior of ethnical units, so that the peculiarities of Chinese psychology and behavior may be explained as the result of their glandular complexes." The study of the process of growth, it is suggested, may even serve as a method of discovering the chemical components of the ethnical units. Are these components laid down in the chromosomal packets?

Clinical mongolism, which, of course, is in no way to be confused with ethnical differentiation, raises similar questions concerning the rôle of early glandular secretion. The cause of mongolism is unknown. Neuropathic heredity, familial characteristics, syphilitic, alcoholic, tuberculous and arthritic lesions are rarely and irregularly involved. More frequent are influences which disturb pregnancy such as advanced age or exhaustion of mothers, numerous previous pregnancies, privations, violent emotion, etc. But even these influences are subject to exception and to error of interpretation. The fact that mongolism may occur in one of fraternal twins, and has not been reported in only one of identical twins, suggests the existence of a germinal defect. To be so much in the dark as to the etiology of such a well-defined clinical entity as mongolism suggests the need of great caution in assigning the cause of congenital defect.

[1] Shirokogoroff, S. M., "Process of Physical Growth among the Chinese," Vol. 1, *The Chinese of Chekiang and Kinagsu.* The Commercial Press, Ltd., Shanghai, China, 1925. 137 pp.

Congenital total hemihypertrophy, particularly when found in association with mental defect, would naturally suggest a defective germ plasm. The available evidence does not support this suggestion, but favors the view that some epigenetic factors relating to regulation of symmetry are responsible for the anomaly and all its correlated disturbances in tissue development, including partial cerebral agenesis. To be sure, the imbalance in twinning may itself be ascribed to an original defect in the genes; but it is more in accord with the law of parsimony to ascribe it to some failure in the mechanism of growth regulation. However, whether germinal or epigenetic in origin, the anomaly becomes established at an extremely early embryonic period, and projects itself irrevocably into the entire growth cycle. It becomes an inherent even if not inherited character, and is an excellent illustration of projective importance of early developmental deviations.

4. INHERENT FACTORS IN HANDEDNESS

Handedness is a form of asymmetry which likewise may be interpreted in terms of the physiology of twinning. Perfect ambidexterity would assume ideal symmetry in body build, and complete ambivalence in the two cerebral hemispheres. Such perfect balance, theoretically and actually, must be a rarity, which, if it ever exists, tends to be overthrown even in the intra-uterine stage of development with postural and gravitational adaptations. In the great majority of instances the balance is thrown in favor of the right hand and the right eye. Accompanying, following, or determining this unidextrality is a dominance of one of the cerebral hemispheres. Is this cerebral dominance strictly hereditary, or is it an epigenetic by-product of developmental mechanics comparable in a broad way in its genesis to hemihypertrophy?

At any rate handedness becomes inherent, and becomes part of the constitutional make-up of the individual.

The fact that left-handedness is sometimes a familial trait suggests the existence of germinal factors; but not conclusively, because the sinistrality may still be a secondary by-product of a more fundamental familial trait involving vascular or anatomical peculiarities. The frequency of left-handedness in twins suggests an epigenetic factor of a regulatory nature. The increment of unidextrality at adolescence as shown by increased disparity in dynamometer records again suggests basic germinal determiners. The fact that even among left-handed and right-handed individuals there is a wide range of variation with respect to the intensity or degree of the handedness suggests that unidextrality is based on inherent constitutional rather than cultural factors.

All these considerations cast doubt on the theory that handedness is a result of social conditioning. Suppose that all the left-handed individuals in the world arose in their might and imposed a left-handed civilization for a period of fifty years. Is it probable that the infants of that era would be relatively bidextrous for six months, reach for the cube with the left hand at nine months, and be consistently left-handed at one year? Under extremely diverse, ambiguous and intermittent social suggestions, we have found that the great majority of infants of the present day show a progressive tendency toward right-handedness which becomes well established in the second half of the first year. The fact that under similar conditions a significant minority of infants show equally well defined left-handedness, is itself suggestive of more deep-seated physiological if not hereditary factors.

We may cite briefly the case of an infant who showed evidence of left-handedness in the very first day of his post-

natal existence. He amused the nurses by the vigorous manner in which he sucked his left hand. When questioned the nurses reported that it was always his *left* hand which went to his mouth. His mother, a good observer, does not recall that he ever used the right hand instead. When the time came to use the domestic implements of culture, spoon, crayon, cup, toys, handkerchief, etc., he consistently showed preference for the left hand. Pictures at this time indicate that he consistently crossed his legs in sitting posture in a manner different from his right-handed sister. His parents, persuaded that handedness was the result of social conditioning, used judicious and persistent suggestion to favor the right hand. The porridge might be eaten with the left hand, but dessert must always be eaten with the right hand. Hedonic association could not be better planned. When ready for school entrance this boy was psychologically examined. He proved to be a boy of superior intelligence, but with relatively inferior output in drawing, even though his father is an artist.

In all his manual activities he showed an inveterate preference for right to left and contraclockwise movements. When it came to drawing a locomotive with crayon, the smoke streamed to the left; likewise, when it came to reading his first letters on signs and in books, he proceeded from right to left. K. I. was read as I. K. Letters and numbers were mirror written. There can be no doubt that this boy has a constitutional flare toward left-handed performance, and would be more comfortable in a sinistral society. He is reported in this detail to show that systematic social conditioning cannot overcome inherent left-handedness; and to indicate that its inherency may date from birth.

5. THE EARLY GENESIS OF INDIVIDUAL DIFFERENCES

Concerning the inheritance of specific abilities, our data furnish only indirect suggestion. Specific ability in drawing, special interest in music, marked sociality, early facility in language, precocity in the use of generalizations and abstractions, all these manifest themselves in infancy in a way suggestive of native gifts or predispositions. If conditioning during infancy were responsible for such individual differences, there would be much more similarity between siblings and twins than is actually found. The extreme form of the theory of conditioning proves too much; for if it held, there would be numerous instances of bizarre ability and grotesque psychological resemblance between brothers and sisters.

Our data as a whole and clinical experience with infants give no confirmation to the theory that infants start abreast at a straight base line parallel with the threshold of birth, and that psychological differences among individuals rise by cumulative and selective action on a homogeneous protoplasmic Urstoff which in quality and amount is equally apportioned. Minute anthropometric measurements of foetuses show that racial and individual peculiarites of structure in face, hand, foot, are demonstrable in the prenatal stage. If this is true of bones, muscles, and skin, there is no reason why it should not be true of the internal structure of the nervous system. The plasticity of the nervous system is not in itself inconsistent with a considerable degree of native differentiation. The "appalling" resemblance between man and the ape in the prenatal period has been exaggerated; because beneath and beyond the resemblance are differences, less obvious but of extreme developmental importance. Indeed in this field of comparative anatomy and comparative psychology the differences are almost more

in need of scientific definition than the more easily discoverable correspondences. The study of such differences shows that the distinctive human and individual traits come not by way of addition to a common substructure, but are laid down in the substructure itself.

If we are to ascertain the genesis of human deviations we must first of all determine how early in life such deviations assert themselves. Investigation must be directed more and more to the period of infancy. The time of the genesis of individual differences is part of the question of the mode of genesis.

Bearing on this point, brief reference may be made to a study in which Miss Elizabeth Lord and the writer reported a psychological comparison of eleven pairs of nursery school children who were comparable as to age and school experience but contrastive as to the socio-economic status of their homes.[1] One child in each pair came from an underprivileged home, the other from a favored home with father or mother occupationally at the professional level. Individual tests, measurements, and clinical estimates were made of each child on fifteen items yielding 330 comparative findings. There was a definite bimodal tendency in the distribution of these findings, the higher ratings gravitating strongly to the favored group. The data suggest that the basic growth factors which will differentiate the abilities and personalities of these twenty-two children in adult years were in operation at least as early as the age of two or three years.

These differentiating growth characteristics began to operate when? The difficulty of fixing the zero point in

[1] Arnold Gesell and Elizabeth Evans Lord, "A Psychological Comparison of Nursery School Children from Homes of Low and High Economic Status," *Pedagogical Seminary and Journal of Genetic Psychology*, September, 1927.

answer to this question is itself a partial answer to the question. There is no conclusive control experiment. The same infants would have to be rereared in converse homes and converse schools to furnish complete evidence. It is probable that in the field of personality characteristics, emotional attitudes, interests, and preferences, the greatest reversal of ratings would occur. But this would not argue that the fundamental growth potency can be radically altered by a change of milieu.

It is doubtful whether the basic temperamental qualities of infants can be measurably altered by environmental influence. Training and hygiene may exert very palpable and important influence in the organization of the personality without necessarily altering the underlying naturel or habitus. We have been particularly impressed with a difference in temperamental reactions in a pair of twins, of the fraternal type, who have been under close observation for a period of several months dating from birth. Even in these early months mother and examiner are agreed that there is a consistent difference between the twins with respect to such matters as placidity, length of crying, vigor of protest, tolerance of physical discomfort, readiness of smiling, social responsiveness, etc. With the same home, the same mother, similar physical health, it is highly probable that these differences in emotivity bespeak an inherent if not inborn difference in temperamental make-up. Experience and education will not so much modify as they will (and should) be modified by this native difference. (See page 294ff.)

The temperamental characteristics of C. D. (Chapter VIII) may be recalled here. This girl exhibited a striking degree of amenability, sociality, and good nature as early as the age of nine months. We have followed her career closely. She is now five years of age, and in spite of a varied experience in boarding homes and institutions she has not lost these engaging characteristics. They are part and parcel of her make-up quite as much as the lowered tempo and the lowered trend of her general development. It can be predicted with much certainty that she will retain her present emotional equipment when she is an adolescent and an adult. But more than this cannot be predicted in the field of personality. For whether she becomes a delinquent, and she is potentially one, will depend upon her subsequent training, conditioning, and supervision. She is potentially, also, a willing, helpful, productive worker. Environment retains a critical rôle even though heredity sets metes and bounds.

The very essence of mental growth lies in this mixture of determinateness and indeterminateness. Tempo, trend, and temperament are in large measure determined by inherent or hereditary factors; but the wealth of detail in the dynamic pattern which we call personality is indeterminate until it is defined through experience. Growth potency is fundamentally dependent on original equipment; but the personality make-up is almost literally fabricated by the social conditions in which the young mind grows.

6. PERSONALITY FORMATION AND THE WEB OF LIFE

Indeed, the child's "personality make-up," so far as it is a describable subsisting reality, consists in the countless conditioned reflexes, associative memories, habits and attitudes which it acquires as a result of being reared by personal beings. If he were never touched by ministering hands, if he did not see and hear the evidences of humanity, if he could grow up in an absolutely asocial vacuum, it is difficult to believe that he would have any recognizable "personality make-up" at all. The balance, the topography, the well-

being of personality depend to a remarkable degree upon the impress of other personalities.

The biologist emphasizes the marvelous interrelation and integration of all the organic world or the web of life. Through the sensitive, sifting processes of evolution, all forms of life have in some way become interdependent. All species are thus adapted to each other.

This conceptual image of the web of life, Thomson[1] considers one of the four great ideas in Darwinism. "To put it in the coldest way, there seems to be a tendency in animate nature towards the correlation of organisms." "Nature is seen more and more vividly as a fabric." "The circle of one creature's life cuts into many other circles." The relationships are not in static completion or stable design. On a majestic scale which comprises the whole organic world, evolution continues to slowly modify both the organisms and the total pattern of mutual adaptations. This complex system of interrelations "forms an external registration of evolutionary gains and a sieve by which variations, sometimes subtle nuances, one might think, are effectually sifted."

The mechanism of evolution and the mechanism of growth, after all, have much in common. The most striking difference relates to time. What evolution achieves in ages, the infant in his growth accomplishes in brief moments. But he grows and adapts in a manner which is measurably comparable to the evolutionary process.

The image of the web of life is, in fact, applicable to the mechanics of personality formation. It is possible to think of each personal complex of mental growth as a brief compression of events staged in a little theater in which the

[1] Thomson, J. A., *Concerning Evolution.* Yale University Press, 1925. 245 pp.

individual achieves a unique but conditioned system of adaptations to the whole human family. Here again is a correlation of organisms, based on the interactions and the interdependencies of contiguous personalities. Here, too, in the mental development of each new infant we glimpse the strands of nature's vast web of life, a ceaseless process of adaptation to other individuals, an interplay which inevitably registers itself in the delicate tissue of the child's growing personality.

All children are thus, through correlation, adapted to their parents and to each other. Even the maladjustments between parent and child are adaptations in a psycho-biological sense and can only be comprehended if we view them as lawfully conditioned modes of adaptation. Growth is again the key concept. For better or for worse, children and their elders must grow up with each other, which means in interrelation one to the other. The roots of the growth of the infant's personality reach into other human beings.

These considerations give great emphasis to the environmental or psychodynamic importance of the parent-infant relationship. This relationship is so fundamental that it may be construed in biological as well as cultural terms. Indeed even in infrahuman family life there are noteworthy manifestations of parental behavior. The more basic principles of interaction between child and parent can be fruitfully analyzed by means of such biological categories as *parasitism*, *symbiosis*, and *commensalism*. In the present volume, no space will be devoted to these details. It is sufficient to point out that the personality configuration of the child is not determined by germinal constitution, and that it is a product of growth regulation. The regulation is accomplished both consciously and unconsciously through the social interaction between the young child and his house-

hold. The association of parent and child is a kind of psychobiological partnership. It is infinitely more complicated than a mere nutritional arrangement, but it obeys similar laws of nature, and lies equally in the sphere of human control.

It appears, then, in summary, that there is a profound interdependence between "heredity" and "environment" in the control of development. These terms, from tradition, are dualistic in connotation, but growth itself is integrative and resolves the antithesis. The ancient antinomy of determinism versus freedom likewise seems inapplicable to the facts of growth. All growth is lawful and in that sense determined. The intrinsic determiners of development work in conformance to genetic laws, the extrinsic factors work in similar and coördinated conformance. The spheres of intrinsic and extrinsic influence are not separate but interpenetrate, and scientifically, if not metaphysically, it is impossible to assign a unique and absolute autonomy to any factor which enters into the growth complex. Even the originative and mutational manifestations always emerge in and out of a zone of growth. They may be unpredictable; but they are not pure miracles. From the standpoint of scientific policy they must be brought within the scope of developmental law.

There is after all a difference between predeterminism and determinism. Scientific determinism does not spell foreordination; but aims to bring even "freedom" within the limits of law and therefore also within the limits of comprehension. An absolutely whimsical and fortuitous freedom would be as offensive to understanding as a stereotyped predestination. In organic evolution and in the growth of the individual these divergent extremes are kept in progressive check and balance. Viewed from one aspect, the phenomena of growth are impressive for their conservative

stability; viewed from another aspect they are impressive for their productive fertility. Plasticity is neither a negative nor a passive character. It is a positive "function of growth," a method of transconstruction or assimilation.

The concept of heredity in its classic simplicity is contradicted by the existence of this kind of plasticity. Apparently there is a process of competition and selection in the formative complex of growth. Even native endowment comes not as a discrete bequest, but is built up through the sifting influence of competition among variable components. Some of these survive, others give way. The native endowment is thus built up through the screening stress of growth, and is a product of growth as well as of germinal constitution. Not all potentialities are realized, but only those which pass the mesh of already attained organization. All growth is self limited. Growth is mainly determined by previous growth. But this is a progressive kind of determinism which in the field of behavior, at least, comes under human control, and is inconsistent with a fatalistic view of infancy.

These considerations are general. They may be given concreteness if we formulate them briefly in terms of growth potency, personality, and the nervous system. Growth potency is broadly and fundamentally determined by inheritance. The basic developmental tempo, trend, and temperament are mainly inherent individual characteristics. Personality in its most pervasive and inclusive sense is mainly a product of the conditions of development. Maturation proceeds from intrinsic potentiality; organization issues from extrinsic and experiential determinants. But utmost realization of growth potency depends upon maximum organization.

The nervous system stands supreme among the federation of organs which together constitute the human individual.

Its supremacy consists in the function of maintaining and furthering the integrity of the body and its behavior. By virtue of this function nature has safeguarded it with certain distinctive growth characteristics. Among all the organs of the body the nervous system manifests a high degree of autonomy in paradoxical union with a high degree of impressionability. It is remarkably resistant to adversity. It withstands much deprivation. When other organs of the body starve, it does not starve as much as they do. This relative invulnerability gives it a certain stability in the somatic competition between organ systems. It tends to grow in obedience to inborn determiners, whether saddled with handicap or favored with opportunity. It responds to opportunity and capitalizes it; but its supreme function is the optimum integration of the individual in all circumstances.

All things considered, the inevitableness and surety of maturation are the most impressive characteristic of early development. It is the hereditary ballast which conserves and stabilizes the growth of each individual infant. It is indigenous in its impulsion; but we may well be grateful for this degree of determinism. If it did not exist the infant would be a victim of a flaccid malleability which is sometimes romantically ascribed to him. His mind, his spirit, his personality would fall a ready prey to disease, to starvation, to malnutrition, and worst of all to misguided management. As it is, the inborn tendency toward optimum development is so inveterate that he benefits liberally from what is good in our practice, and suffers less than he logically should from our unenlightenment. Only if we give respect to this inner core of inheritance can we respect the important individual differences which distinguish infants as well as men.

CHAPTER XVIII

THE CLINICAL PREDICTION OF MENTAL GROWTH

Possibilities and Limitations of Developmental Prediction

Since prediction is a formidable, not to say pretentious, term when applied to something so admittedly complex as human development, it is desirable to subject the concept of predictability to critical consideration. Theoretically, prediction is a natural outcome of measurement. Indeed one implies the other. A perfect measurement of maturation would designate in one or more formulae an exact degree of attained maturity and a corresponding degree of potential maturity. Every moment of development (above the level of zero) possesses, so to speak, a value which is both kinetic and latent; because attained development is under uniform conditions the true index of prospective development. In this theoretically ideal sense the cycle of maturation is as predictable as the orbit of a comet, even though there is actually no mathematical methodology available; and even though an organic cycle is infinitely more complex than an astronomical one.

The intricacy of the organic cycle does not, however, in itself contradict the possibility of prediction. The intricacy is not anarchic; it is self-limited and integrated. It coheres by its own complex system of checks and counter-checks. For this reason, in spite of a stupendous range of