CHAPTER II

THE RHYTHM OF GROWTH

Growth has a rhythm. The essence of rhythm is pattern. Pattern means sequence. Each child has his own rhythm and pattern of growth within a general developmental sequence shared by all children. Most school systems are organized on a general sequential basis determined by age-related norms and do not take into serious consideration the individual's rhythm of growth. Age-grading in the schools almost always involves an evaluation system built around a group norm and the use of bell-shaped curves which guarantee a "below average" performance for a significant percentage of any class. This means that approximately half of the children whose timing -- whose rhythm and pattern -- is not congruent with the norm are penalized. Sustaining such "punishment" over long periods of time has far-reaching implications for the emergence of dysfunctional self-images and the suppression of potential.

Being taught by a teacher who does not sense one's rhythm and pattern of growth is very much like trying to dance with someone who can't feel the beat of the music. Movements are jerky, toes are stepped on, stumbling is inevitable and one always feels that he is moving in the wrong direction. The whole affair is embarrassing and uncomfortable. Under such conditions there is little hope for romance.[1]

But education should be a love affair with learning. A great deal of educational literature is devoted to the problem of getting the love affair

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[1] It is interesting to note that Whitehead identifies three basic stages one goes through in any period of development: romance, precision, and generalization. See Whitehead, A. N. Aims of Education. London: Williams and Norgate, 1950, pp. 24-65.

going. Individualized instruction has indeed become a hallowed byword in most educational circles and materials that are ostensibly designed to meet the individualized needs of children are abundant. However, so long as the major focus in education remains on "what to learn" rather than on "how to learn", individualization of instruction cannot be institutionalized. Emphasis on factual content (the what to learn) takes the attention off process (the how to learn). The focus on process means giving consideration to everything that is known about the growth and development of children. Without active application of such knowledge, we will continue to fail to produce in any significant way on the commitment to meet individual needs. Thus, a theory of development must precede learning theory and curriculum theory. Once the rhythm of growth and development is understood and felt it is then possible to orchestrate the kinds of experiences which are most appropriate for each child in terms of his particular level of functioning and development. The theory of development presented here anticipates our definition of learning competence and our theory of curriculum.

Developmental Theory

It is the function of theory to provide a systematic means of ordering the phenomena being investigated so that relationships among them can be explained and understood. The phenomena we are now considering are the endless number of changes that characterize the life of the human being. These changes are not random; as we have

indicated, they reflect sequence and orderliness. Two general terms have been used to describe these orderly changes: growth and development. Technically, growth refers to increase in size, while development means "increase in structural and functional complexity" (Montagu, 1962, p. 19). Both growth and development occur simultaneously during the first quarter of life, but development may continue on some levels until death.

Development is a series of stages of organization, each one of which is simultaneously involved in maintaining continuity or stability in the organism while at the same time generating discontinuity or transformation. Jonas Langer (1969, p. 89) expresses the concept of development in evolutionary terms:

> The fundamental thesis is that evolution is a systematic process that interweaves two antithetical organismic tendencies: to maintain continuity in order to conserve one's integrity (survival and organizational coherence) and to elaborate discontinuity in order to develop.

This definition is consistent with the philosophical base derived from Whitehead's philosophy of organism and fits into Werner's orthogenic principle as applied to mental development (Werner, 1957). Werner (1948) asserts that:

> . . . development is the process of increasing differentiation and specification of the organism's relatively global organization, coupled with the process of progressive centralization and hierarchical integration of the more individuated systems so that progressive equilibrium is achieved.

Differentiation leads to individuation -- progressive hierarchical integration. The two, differentiation and integration, constitute

the dynamics of development. They represent discontinuity and continuity -- what in Whitehead's terms would be regarded as "many in the one" and the "permanence within the flux".

Sensitive Periods and Critical Periods

The rate of change, or flux, is not steady. During some periods the rate increases; at others, it decreases. Associated with this periodicity, there are times of maximum susceptibility to influence, either positive or negative, from stimuli, drugs, lack of nutrients, or other kinds of deprivation (Escalona, 1968). This span of time is called a "sensitive period". If [redacted] susceptibility to a particular developmental modifier is limited only to the sensitive period, that is, if the modifier is introduced prior to the period or after the period and nothing happens, then the sensitive period is designated a "critical period".

The existence of sensitive and critical periods during the life of the embryo is well established. During embryogenesis, organs or tissues which enter a period of rapid growth tend to be more sensitive to positive or negative influences, whereas either before or after that period there may be little effect. For example, the genital system makes its appearance in the human embryo during the fifth and sixth weeks. This is sometimes called the indifferent period because the sex of the embryo is still morphologically undetermined; the embryo has a pair of generalized sex glands which are not yet differentiated into testes or ovaries. From the end of the sixth week, particular hormones begin to exercise their influence on these glands.

By the eighth week, the sex of the embryo can be identified by examination of its external genitalia. Thus, the critical period of sexual differentiation in the human embryo is between the fifth and eighth weeks (Montagu, 1962, p. 350). To cite another example, if a mother contracts rubella (German measles) during the first three months of pregnancy, the time when eyes and ears of the fetus are forming, it is highly probable that the child will suffer from some degree of blindness or deafness (Landreth, 1967, p. 20). The embryo is also particularly sensitive to some drugs at particular times. Certain chemicals used as therapeutic agents at normal periods when administered during pregnancy have been found to have teratogenic effects on the unborn, such as malformation of the ears, absence of certain bones, and abnormalities of the heart, kidneys, and gall bladder.[1] A large variety of damaging influences during critical periods have been recorded (Jones, 1967).

Are there similar periods for the development of specific behavioral patterns? In the case of many animals, the answer is definitely yes. Certain species of birds and animals have off-spring that possess well-developed sense organs and are capable of locomotion shortly after birth. Lambs, kids, calves, and fledglings of ground nesting fowl such as domestic chicks, goslings and ducklings all belong to this category of precocial species. During a specific

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[1]The drug, thalidomide, is a well-known case in point.

period of time after birth, off-spring of these species learn to follow moving objects, usually their parents and siblings. This innate following response, called imprinting, is released only during a particular period. Extensive studies have shown that if parents or siblings are not around during the critical period (which for ducks is around twelve hours after hatching, for example), the off-spring may be imprinted on some other moving object, animate or inanimate, including human beings (Slukin, 1965). There are many cases of bottle-fed lambs which came to be imprinted on their human care-takers. Lambs so imprinted form such attachments that they no longer associate with sheep but prefer to remain with human beings. When such lambs grow up and produce their own off-spring, they show abnormal maternal behavior (Scott, 1945).

Harlow (1962) found from a study on young rhesus monkeys that they form strong social bonds among themselves between the third and sixth month after birth. Social deprivation during this time permanently impairs their ability to achieve a satisfactory "social adjustment". Scott (1958) demonstrated that the only time when puppies are capable of forming lasting attachments to people and other dogs is between the third and seventh week after birth. He reasons that just as the early development of cells or organs in the embryo determines permanently all later anatomical structures, so does the early learning determine later behavior and permanently prohibits any re-patterning of behavior at some later time. He believes that critical periods are of utmost importance in determining emotional, intellectual, and social developments of any

human being. Most researchers, however, are more cautious in ascribing criticality to a sensitive period of "primary socialization" such as that described by Scott. Hess suggested a correspondence between the abnormal behavior of chicks which were placed in social isolation during the imprinting period and the "apathetic, nervous, or hostile behaviors" which have been observed in orphanage children who also experienced a kind of social isolation because they were never allowed to form attachments to significant others during the first few months of life. Denenberg (1964) proposes a more general view of the early months as a period when lack of stimulation will result in higher degrees of emotionality and instability in later life. He carried out extensive studies on the relationship between the amount of stimulus input during infancy and emotional reactivity in later life. Most of these studies were carried out on rats and mice. They demonstrate that the animals which have been shocked or handled a great deal grow faster, learn to run mazes better and in general have greater survival capabilities then those animals which had limited stimulus input during infancy. It appears that cuddling, gentle handling and an abundance of stimulation are also essential to development to the human infant.

No clear examples of imprinting can be found in human beings. There is likely to be minimal correspondence between imprinting and the early behavior of the human being simply because of the increasingly dominant role in all complex behavior patterns assumed by the cerebral cortex in the course of evolution. Human beings function at a higher phylogenetic level and are therefore more responsive to environmental influences and

less dependent upon maturational processes. However, on the assumption of the evolutionary continuity between the animals and man it is not unreasonable to speculate that the effects of imprinting might not entirely disappear as a factor in early development of the human infant. Gray (1958) reviewed a number of studies concerned with the smiling response and the effects of early deprivation due to institutionalization. On the basis of these studies he suggested that imprinting might also be the basis for the development of the human personality. Bowlby (1957) has also regarded smiling as a response releasable by appropriate stimuli very much in the imprinting sense. As Bowlby explains it, a particular figure, usually that of the mother, becomes distinguishable from the environmental background by the infant during the first six months. Smiling comes with the clear recognition of the mother, after which time the child develops an attachment that continues to grow stronger with time. There appears to be a sensitive period during which time this attachment takes place. Children reared in institutions or hospitals frequently miss this period and therefore tend to be maladjusted.

Whether or not we can relate certain periods of susceptibility in humans to imprinting, there do seem to be particular periods in time when there is a readiness to learn specific behaviors or perform particular mental operations. Learning to crawl, walk, speak[1] and read tend to appear at particular times in an invariant sequence that are roughly the same for all children. Growth and development are thus characterized by periodicity--critical and sensitive periods, many of which appear in an

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[1]Lenneberg (1964), for example, has confirmed the existence of a critical period for language development.

invariant sequence. There are two basic categories of influences which have their maximum effect during these periods: nutrition and experience. The first influence is mediated through biochemical means, the second through learning.

Nutrition and Development

The most critical period for the morphological development and functioning of the brain and the central nervous system of the human infant is from three months before to six months after birth (Winick, 1969). A protein-calorie deficiency in the diet[1] during this time will cause smaller and less mature brains in the infant (Coursin, 1965). Once formed, the myelin sheath which insulates nerve fibers seems to be resistant to modification during the rest of the organism's lifetime. It is now recognized that during its development, however, the myelin sheath is particularly vulnerable to the stress of undernutrition. Because the period of greatest growth of the central nervous system, including the myelin sheath, is late prenatal and early postnatal, much of its resistance or vulnerability to the effects of malnutrition has been established by the time the child is ready to assimilate nutrients from the regular food supply.[2] Early malnutrition also has a detrimental effect on the auditory-visual integrative function and on neuro-integrative behavior in general (Cravioto, 1967a, 1967b).

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[1] Prolonged intake of foods low in protein in spite of excess or adequate supply of calories from carbohydrate sources causes a malnutritional condition called kwashiorkor. Prolonged general starvation which leads to deficiencies of both calories and body building proteins causes infant atrophy called marasmus.

[2] Further implications of these findings are discussed in Deadline for saving starved minds, Medical World News. 9(37):91, 1968.

Even after an adequate structure of the central nervous system has been established, poor nutrition during the following years can severely impair the neuro-physiological bases of learning and behavior. Thiamine deprivation causes anxiety, irritability, depression, and increased sensitivity to noise and pain. Nicotonic acid deficiency results in lassitude, apprehension, and depression. Deficiency of vitamin B_{12} can cause mental confusion; a lack of iodine may lower the basal metabolic rate and cause physical and mental languor. Insufficient iron results in lowered hemoglobin which reduces the capacity for the blood to carry oxygen; this has a depressive effect on motor activity (Leverton, 1971).

The specific detrimental effects of undernutrition on the functions of the central nervous system depend upon the time of the deprivation and its nature, duration, and severity. The degree to which such effects can be reversed, if at all, depends upon the interaction of the same factors with the intensity and duration of the therapeutic regimen.

It has been estimated that the human body needs at all times during its life cycle particular amounts of some sixty chemical elements or compounds which must be provided from exogenous sources. The body cannot biosynthesize them at all or cannot make enough of them. Several endocrine glands have particular significance for the development of the organism for they produce hormones that regulate the growth and functioning of the central nervous system. The production of thyroxine by the thyroid glands, for example, is essential for the development of cortical neurons. The thyroid glands require trace amounts of iodine to synthesize thyroxine. Without this hormone, neurons fail to show the intricate branching that

forms the basis for an elaborate network of inter-connections among them in the brain. Children who experience this iodine deficiency during their first year of life sustain irreversible damage and never develop normal mental abilities (Montagu, 1962, p. 97).

A number of other studies (Dreyfus, 1966 ; Ricciuti, 1970 ; Stoch & Smythe, 1968), have demonstrated that the earlier malnutrition is sustained by the child, the more difficult it is for him to recover. In many cases, children recovering from early malnutrition may appear clinically normal, but their I.Q.'s will be lower than average.

Learning and Development

Our knowledge of the kind of development that depends on learning is not nearly so definitive as our knowledge of the role of nutrition in development. Thus, theory about psychological development is called upon to fill in an extraordinary gap: "from reflexes and undirected movements to logical reasoning, values, and creative imagination" (Woodward, 1971, p. 14).

There are a number of theories about the kinds of development that depend primarily on learning. We briefly present two of the most well-known ones here as basic illustrations and as an introduction to our own tentative formulation of a basic scheme out of which a comprehensive theory is being developed.

Erikson's theory of psycho-social development is a very clear example of a theory that has broad explanatory utility (Erikson, 1950). His theory is unusual in that each stage of the developmental process is characterized

by a challenge that must be met if the individual is to progress successfully to the next stage. It also predicts what happens when the challenge of a given developmental stage is not successfully met and describes the nature of the developmental impairment. Each stage thus represents a sensitive period during which time certain experiences are needed to meet the challenge successfully. The requirement of the first psycho-social stage (0- to 1-1/2 years) is gaining a sense of trust. If the child does not learn to trust, he will develop a general "mistrusting" orientation to other human beings and the environment in general. The theory suggests that gaining a sense of trust is a major challenge to be negotiated at this early stage in development and that experiences of the child with those who care for him, particularly his mother, are central to its development. Given careful attention and love, a child begins to see himself as separate from other elements in his environment that he must relate to. Trusting enables him to approach these elements; mistrusting causes him to withdraw. During the next stage (18 months to 3-1/2 years), the child must develop autonomy or experience shame. Autonomy not only means a pleasant independence but also includes tantrums, stubbornness, and a certain amount of negativism. If autonomy is not achieved, dependence and shame may result. In excessive amounts, both of these are suppressive of human potential. From approximately three to six years of age, the child must learn how to take a more active role in interacting with his environment. Erikson calls this stage the "initiative versus guilt" phase of development. If parental control is too severe and hostile,

the child will have little initiative and will be immobilized by guilt. A child who is made to feel unjustifiably guilty will find himself unable to move into new directions at his own initiative; this impairs the development of other potentialities. The fourth stage (through age 13) is represented by industry--learning and mastering a large number of skills--and experiencing the satisfaction of accomplishment. If industry is not achieved, inferiority results. If this inferiority is coupled with the shame and guilt left over from the unsuccessful negotiations of previous stages, personality disorders, neurosis, and other precursors of emotional disturbance may result. During adolescence (to age 20), an integration of the personality must be achieved, self-confidence must replace self-consciousness; a solid identity must emerge--one that enables a person to look forward to adulthood. If identity is not achieved, the person may sustain identity diffusion and a consequent confusion in goals, directions, and feelings about himself. In the next stage, the young adult must learn the joys and responsibilities of intimacy in preparation for marriage and lasting friendships. If the capacity for intimacy is not achieved, the person faces isolation. In isolation, the human being is cut off from a wide variety of stimuli which is essential to the further development of potentialities. Once intimacy is achieved, the adult is ready for generativity--having children and enjoying the satisfactions of parenthood while undertaking creative and productive work. The alternative to generativity is self-absorption, a kind of turning in on oneself characterized by depression and lack of motivation. Finally, if all other stages are negotiated successfully, the person achieves integrity. He is independent, creative, trusting, secure, and he is able to enjoy

the harvest of his life; he knows how to withdraw from it successfully in preparation for death. The alternative to integrity is despair and self-rejection.

In contrast to Erikson's theory of psycho-social development, the work of Jean Piaget centers primarily on cognitive development and grew out of his interest in Baldwin's idea of genetic epistemology [1] (Baldwin, 1915). Piaget (1970) calls the first stage of development the sensori-motor stage. It is divided into six stages beginning with undifferentiated reflex activity, proceeds through hand-mouth and hand-eye coordination, discovery of new means of experimentation, to an internal representation of experience which enables the child to use sensori-motor means to solve simple problems. The second period of development (from two to seven years) is called pre-operational. It includes the development of language and is characterized by pre-logical and egocentric thought. During the next period, concrete operations (from seven to eleven years), the child moves from pre-logical thought to the mastery of logical operations which can be applied to concrete problems, including those involving conservation.[2] In the final period, formal operations (eleven to fifteen years), the child moves from the use of logical solutions to concrete problems to the application of logical thought and reasoning to all classes of problems,

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[1] Genetic epistemology refers to a study of the nature of knowledge and how we come to acquire it.

[2] Conservation is the ability to determine through reasoning why an amount or quantity of a substance does not change with an alteration in shape or position.

including highly complex issues which deal primarily with abstractions. During this time, his cognitive structures reach a basic maturity.

Though there are many things that remain unknown about the developmental process, one thing is certain: the rate of development varies over time and some periods may be more important developmentally than others. The idea of sensitive periods understood in a general educational context is not new. The Greeks and Romans knew the value of certain experiences during the early years. Plato emphasized that, "the first shoot of any plant, if it makes a good start, has the greatest effect in helping it to attain its mature excellence" (Plato, p. 377). Quintilian (Book 1, p. 5) observed that "as the twig is bent, so shall the tree be inclined" and that "we are by nature most tenacious of what we have embibed in our infant years". Plutarch wrote that "childhood is a tender thing and easily wrought into any shape" (Monroe, 1906, p. 308).

Pioneers in educational theory also took note of the same phenomenon. Pestalozzi, the famous Swiss educator, felt very strongly that:

> . . . nature has enclosed man's higher aptitudes as in a shell; if you break the shell before it opens on its own you will find only a budding pearl. You will have destroyed the treasure you should have preserved . . . . (Lawrence, 1970, p. 63)

Montessori (1936, pp. 35-36), who attributes her interest in sensitive periods to the Dutch biologist Hugo DeVries, claims to be the first person to "discover the sensitive periods of infancy and to make use of them from the standpoint of education". In defining

critical periods, Montessori (1936, p. 36) stated that:

> . . . they are transitory and confined to the acquisition of a certain characteristic. Once this characteristic has evolved, the corresponding sensitivity disappears. Thus, every characteristic is established by the help of an impulse, of a transient sensibility which lasts over a limited period of growth, that is, during the corresponding sensitive period.

She observed that inner sensibilities, which occur only during sensitive periods, "determine the selection of necessary things from a many-faceted environment . . . making the child sensitive only toward certain things, leaving him indifferent toward others" (1936, pp. 38-39):

> If the child is prevented from enjoying "certain" experiences at the very time when nature has planned for him to do so, the special sensitivity which draws him to them will vanish with a disturbing effect on his development, and consequently on his maturation (1967, p. 95).

> It is necessary to offer those exercises which correspond to the need of development helped by an organism, and if a child's age has carried him past a certain need, it is never possible to obtain in its fullness a development which missed its proper time. Hence, children grow up often fatally and irrevocably imperfectly developed (1912, p. 358).

While the extent to which all areas of physical and psychological growth have critical or sensitive periods is yet to be determined, the fact remains that research has revealed a number of them. If teachers are to become more competent in individualizing instruction and taking advantage of the moments of highest susceptibility they must be aware of them. A child who is provided with appropriate experiences during each of his sensitive or critical periods has a higher probability of becoming a competent learner--a learner whose potentialities will continue to become actualized throughout his life.

Thus far, we have been considering sensitive and critical periods as they relate to maturation and learning. We propose that the kind of sensitive period which is not innate but is determined by the consolidation of learning at a given level deserves more serious attention. As we have noted, there is an extension of potentiality the moment a significant degree of integration of learning structures or consolidation takes place. The most sensitive time for proceeding to the next level of development is shortly after that consolidation or integration takes place. If that sensitive period is missed, development of the next phase will be delayed and this is akin to the deceleration of the rate of the release of potentialities. As the growing organism matures, these are the sensitive periods which become more significant from an educational point of view. Perhaps the child himself can learn to identify these sensitive periods by developing an inner awareness of his own state of consolidation of learning on a given level, which then prepares him for the next stage. Conscious knowledge of these sensitive periods could enable the person to regulate his interaction with the environment in a way that takes advantage of these "acquired" sensitive periods.

The developmental process is a dynamic interaction of maturation (genetically determined age-related changes) and experience. When experience "fits" a given maturational level or sensitive period, potentialities surface and become fully manifest. When the experience "misfits" there may be little growth and the genetic promise will be only partially fulfilled. This is the problem of the "match" to which Hunt refers (1961, pp. 267-288). It is the broader concern underlying the

problem of individualization of instruction; and to tackle that problem we require a comprehensive developmental theory.

Such a theory would be like a good road map. It could tell the teacher where she is with a given child, where she has been with him, and where they might or should go next. Unfortunately, there as yet exists no comprehensive developmental theories which have been empirically tested. To be useful, both philosophy and theory must be checked out by experience. The formulation and validation of a comprehensive theory of human development--one that speaks to the translation of potentiality into actuality in all its complexity and richness--will require the coordinated efforts of a large number of researchers over a long period of time. In chapters III, IV, and V we present the formative elements for such a comprehensive theory.