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The Anisa model: a scientific paradigm for education and its implications for a theory of evaluation.

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THE ANISA MODEL: A SCIENTIFIC PARADIGM FOR EDUCATION AND ITS IMPLICATIONS FOR A THEORY OF EVALUATION

A Dissertation Presented

By

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DEDICATION

To my mother who prizes education above all; my sisters, brothers, and their husbands and wives who always encourage me; and my wife who gives both meaning and purpose to all my efforts.

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ABSTRACT

THE ANISA MODEL: A SCIENTIFIC
PARADIGM FOR EDUCATION AND ITS IMPLICATIONS
FOR A THEORY OF EVALUATION

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The purpose of the dissertation is three-fold: (1) to establish criteria for assessing scientific theories, (2) to demonstrate how the Anisa Model as a scientific theory represents a new paradigm for education, and (3) to develop the implications of the paradigm for a theory of evaluation. The dissertation is part of a larger effort undertaken by the Anisa Project to help establish the Anisa Model as a discipline in education that unites the discoveries of a wide range of physical, biological, and behavioral sciences. In the growth of scientific knowledge, it will be demonstrated how Anisa represents a new paradigm for education providing a disciplinary matrix, distinctive methods, body of theory, accumulating bodies of data, and implications for practical use. The study, therefore, aspires to establish Anisa as a scientific paradigm for education by giving it a local habitation and a name.

This study determines criteria for evaluating empirically based scientific theories. These criteria, e.g., units of study, precise

data language, explicit assumptions, and ability to generate testable hypotheses, are applied establishing the Anisa Model as an empirically based theory of education.

Thomas S. Kuhn's structure of scientific revolutions is then used to show the growth of scientific knowledge in contrast to the Popper et al. view which holds to the building-block or growth by accumulation. Illustrations from the mature physical sciences demonstrate Kuhn's structure of scientific revolutions. The pattern of growth moves from the philosophical, pre-scientific stage — current status of education — to a mature paradigm, which has the following stages: normal science, puzzle-solving, discovery of anomalies, extraordinary science, and paradigm shift. The mechanistic paradigm is illustrated demonstrating the paradigm shift from Newtonian physics to Einstein's general theory of relativity. The Anisa (organismic) paradigm is presented demonstrating how Anisa fulfills Kuhn's criteria of a scientific paradigm. It shows how the Anisa Model is able to assimilate theoretically the anomalies of the mechanistic paradigm resulting in a major paradigm shift. The Anisa Model, therefore, moves education out of its philosophical, pre-scientific stage to the status of a new paradigm for education.

The implications of the new paradigm for further articulation of the Anisa theory of evaluation are explored. The following issues of "normal science" are addressed: conceptual, instrumental, and methodological. The conceptual problems deal with the significant facts of the paradigm related to its presuppositions concerning the nature of reality. Some of these problems, which involve change, causation, hierarchic organization, emergent phenomena, discontinuity and time are converted into puzzle-form for which Jordan, Bateson, et al. provide tentative solutions.

Implications for new instrumentation focus on a critical review of norm-referenced tests — their development, uses, and abuses. Key measurement problems are converted into puzzle form. The dynamic assessment techniques and methods of Feuerstein's Learning Potential Assessment Device are presented as a radical modification of conventional psychometrics. This approach solves a major assessment problem for Anisa. Criterion-referenced tests, which are appropriate for Anisa practices, are discussed as a constructive alternative to norm-referenced tests. Other areas of needed instrumentation are identified.

Methodological problems and their implications for the development of the Anisa paradigm are addressed and viewed within the paradigm perspective. The research methods used in seven years of field-testing the Anisa Model are reviewed. New methods — new rules and procedures for puzzle solution — identified by the Anisa paradigm are explored. Promising new methods, e.g., Bronfenbrenner's experimental ecology of human development, Bateson's concept of change based on the theory of groups and logical typing, and nomothetic-idiographic designs, are presented.

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INTRODUCTION

F. Raymond McKenna raises a signficant question in the February, 1976 issue of Phi Delta Kappan:

> Notwithstanding advances in psychology and sociology, there is no science of education. Why not? There is a science of medicine furnishing doctors with reliable theory and autonomy; but instead of a science of education providing teachers with the theory and autonomy they need, we have government officials and school administrators telling teachers how and what to do (p. 405).

He then cites thirteen reasons why we have no science of education, e.g., nature of pedagogy precludes theory, policy control by politicians, testing educational theory too complicated, tyranny of how-to-do-itry, etc. Daniel Jordan (1979) observes that the main reason is not on the list for he notes that science is more than knowledge; it is more than a method. Science, for Jordan, means organized knowledge. To put knowledge in usable form, we need an organizing principle. He concludes that the primary reason we have no science of education is the lack of such a principle.

If we equate such an organizing principle and concomitant conceptual model with what Thomas S. Kuhn (1962) has called a "scientific paradigm", the field of education may, nevertheless, still be at the prescientific and philosophical state of affairs or, at best, multiple-paradigm science. A paradigm comprises "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners..."(Kuhn, 1962). A paradigm prevails until anomalies, that is, phenomena that cannot be explained by the paradigm emerge. If such anomalies cannot be explained, alternative paradigms may emerge. An alternative paradigm will ultimately replace the old paradigm if it can better handle the fundamental anomalies. Thus, major scientific advances in a field are likely to emerge "only after a prounounced failure in the normal puzzle-solving activity" within the field, that is, only after a crisis. Real sciences advance through crisis. To experience the latter, we must first have a paradigm. But no theory or methodology in education has ever attained the general acceptance nor status accorded the physical science paradigms cited by Kuhn. Education is experiencing a crisis of confidence related to its multiple theories, most of which are implicitly or explicitly subsumed under the Lockean-Newtonian, mechanistic view of the world.

This writer believes that the Anisa Model deals with the educational crisis of confidence by moving education out of its pre-scientific and philosophical state of affairs to a dual-paradigm science. The Anisa Model, it will be shown, serves as a comprehensive and coherent scientific theory of education. While the Model draws heavily on the physical, biological, and behavioral sciences based on the 19th century Newtonian, mechanistic paradigm, it also represents a shift to a new paradigm with an organismic view by introducing subjective aim and final cause. It represents more than paradigm shift, however, for it represents a totally new scientific paradigm in education. It can be considered analogous to the Newtonian-Einstein theories, i.e., Einstein's general theory of relativity did not disprove Newton's terrestial and celestial laws but made them a special case within a larger framework. The new paradigm, therefore, not only handles many of the anomalies created by the mechanistic paradigm but represents an innovation that could be characterized as a scientific revolution.

The focus of this study is twofold: (1) to establish the basis of the Anisa Model as a new paradigm representing a major paradigm shift and (2) to develop the implications of the paradigm for a theory of evaluation. It has significance, therefore, not only for the broader scientific community for the theoretical elegance of the Anisa Model but a potentially great impact on education. It offers a substantive body of organized knowledge about human growth, development, learning, and behavior that can serve as the basis for professional practice with the ultimate scientific criterion of being capable of empirical testing. Thus, we not only have a scientific model as a basis for educational practice but a major new paradigm which satisfactorily incorporates the old paradigm with the new.

The Anisa Model represents a new scientific paradigm with an explicit theory, i.e., it has data language, assumptions, and can generate new and testable hypotheses. It is concern for the ability of the Model to be empirically tested that is the second major focus of this study. An attempt will be made to develop a theory of evaluation and organizational development as integral systems. As one moves from theoretical statements into the verification of hypotheses (field testing), it will be argued that research and evaluation methodologies are integral parts of organizational structures and processes.

Since the Anisa Model has only been field tested at two sites, the empirical data base is limited. My seven year and continuing involvement as Director of Research for Project Anisa-Suffield and Principal Investigator for Project Inspire provided first-hand experiences in implementing the Model. These experiences in conducting research and evaluation in the field have been helpful in pinpointing problems at both the theoretical and applied levels.

It became abundantly clear that the kind of research methodology to be used is directly related to the theoretical paradigm. Thus, using the Newtonian mechanistic paradigm called for such research designs. These "hard research methodologies" call for control group designs using reliable and valid normative testing instruments. These designs permitted the evaluation of very narrow spectrum of the Model – essentially the content curriculum in reading and mathematics. While this provided valuabe information, the primary goals of the Model – the process curriculum, organizational processes, etc. – did not lend themselves to the use of the "hard methodologies." Since the Anisa Model represents a major paradigm shift with primary focus on process, new research methodologies are required to evaluate these. The state of the art in evaluation of process over time has developed with the use of some of the so-called "soft methodolgies." It is in this area that this study will place great emphasis in clarifying significant problems and possible solutions – the rules and puzzle-solving requirements of a new paradigm.

Method of Inquiry

The method of inquiry will involve a search of the literature concerning scientific model building. The Anisa Model will then be reviewed and evaluated against established criteria used in judging empirically based scientific theories. Since the dominant scientific theories prevailing today are based upon the mechanistic deterministic paradigm, the Anisa Model will be first evaluated within this framework. The study will show how it fulfills accepted criteria of an empirically based scientific model. The inquiry will then use Thomas S. Kuhn's framework to develop the thesis that the Anisa Model represents a major paradigm shift from a mechanistic to an organismic paradigm. The implications of this paradigm shift will be explored as the basis for the Anisa theories of evaluation and administration. A review of the literature from existing theoretical and empirical studies that appear to be consistent with the new paradigm will be conducted.

The inquiry is essentially a conceptual undertaking and largely speculative. The analysis and synthesis of current theories with their empirical data base that lend support to the new paradigm will be the basic means for moving from the context of discovery (hunch) to empirical verification. My seven years of first-hand experience in field testing the Anisa Model in public school systems will also be used to lessen the gap between the purely speculative nature of the inquiry and an empirical data base.

Delimitations of the Inquiry

The study is concerned with the analysis of the structure of science. Essentially, scientific models lead to theories which can be empirically tested by observations. The study will examine this process of assessment.

While a number of criteria for assessing scientific theories will be used, the most important is the number of supporting experimental observations. A theory is judged valid if it precisely accounts for known observations and can make predictions for future measurements. This empirical assessment emphasizes the objectivity of science by maintaining that: (1) observable data can be described in pure observation language and be verified or falsified by experimental data; and (2) deciding between rival theories is a rational process.

Major attacks on the empirical approach, particularly by Thomas Kuhn, questioned this assessment process. Others hold that all data are theory-laden: theories are not verified or falsified; and there are no criteria for chosing between theories of great generality

(Balbour, 1974). Kuhn holds that scientific activities are governed by paradigms, which are determined by an exemplar of scientific work. Observational data and criteria for assessing theories are paradigm-dependent. When a paradigm shift occurs, it is not a rational, objective process of choosing between paradigms but essentially a subjective conversion.

Kuhn obviously disputes the conception of science as being erected from observed and experimentally demonstrated facts. He does not present a theory that can be verified by checking deductions against the facts of nature. Nevertheless, this study will use his framework to assess the Anisa Model and its implications for growth and development of Anisa. Many philosophers of science have credited Kuhn for illuminating the history of science but have disagreed with him on a number of issues (Lakatos and Musgrove, 1970). While some of these issues will be taken into account, this study will focus primarily on Kuhn's structure of the growth of science.

While the Anisa Model may be assessed as fulfilling the criteria of being a scientific theory as well as representing a new paradigm, the verification of the latter can only be determined by events over time. It may also prove to be a false lead; it may not have the necessary and sufficient conditions for a viable paradigm. This study is restricted to implications.

Use of examples from current theories and empirical studies as support suffer from all of the limitations of possibly being incommensurable because of paradigm determiners. Most of this study, by analogy, is conducted in theoretical "hunch land." It attempts to build some bridges to the empirical "land of verification" with its emphasis on implications. Clearly, it is not empirically based.

No attempt is made to be exhaustive; the findings are suggestive of both theoretical areas of needed development as well as new methodologies for empirical research.

The purpose of the study is not an eclectic amalgam for the Anisa Model has a logic and structure of its own. What will be attempted is the clarification of the Anisa Model as a new paradigm, a disciplinary matrix, having distinctive methods, its own history, body of theory, gradually accumulating bodies of data, and implications for practical use. What is missing in the work of my fellow-laborers in this vineyard is a well-articulated theory of evaluation with necessary feedback loops between theory and empirical data. The key to being an empirical scientist is appropriate research methodologies that provide means to alter theory in response to data.

The entire Anisa structure is based on its theory of evaluation; thus, there is a built in tension in this conception of science. Acknowledgement is made of the idea that a scientific paradigm is shaped by its data and in turn shapes them. No simple Baconian program for data accumulation nor hypothetical deductive program for disconfirmation of hypotheses is involved in this process let alone current statistical approaches of factor analysis, multiple discriminant analysis, or computer searches. This results in a corresponding tension in the Anisa conception of man including the Anisa trained research-practitioners.

This dissertation, then, aspires to help establish the Anisa Model as a discipline in education that unites the discoveries of a wide range of physical, biological, and behavioral sciences, and that will have to have its own research methods and spheres of application. The study is meant to help articulate a paradigm by giving it a local habitation and a name.

CHAPTER I

CRITERIA FOR ASSESSING SCIENTIFIC THEORIES

The Anisa Model will be presented as a comprehensive and coherent scientific theory of education. First, issues concerning its status as a scientific theory will be considered; second, it will then be argued that the Anisa Model also represents a major paradigm shift from a mechanistic to an organismic paradigm. Since most scientists usually communicate within a disciplinary matrix, to facilitate communication, focus will be placed on viewing the Anisa Model as a scientific theory subsumed under the concept of the mechanistic paradigm. In order to accomplish this, the following framework will be used as a process for establishing criteria for any empirically based scientific theory.

There are essentially three major steps in the process of constructing a scientific theory: (1) observation, (2) model building, and (3) testing in the real world. This can be schematized as shown in Figure 1.

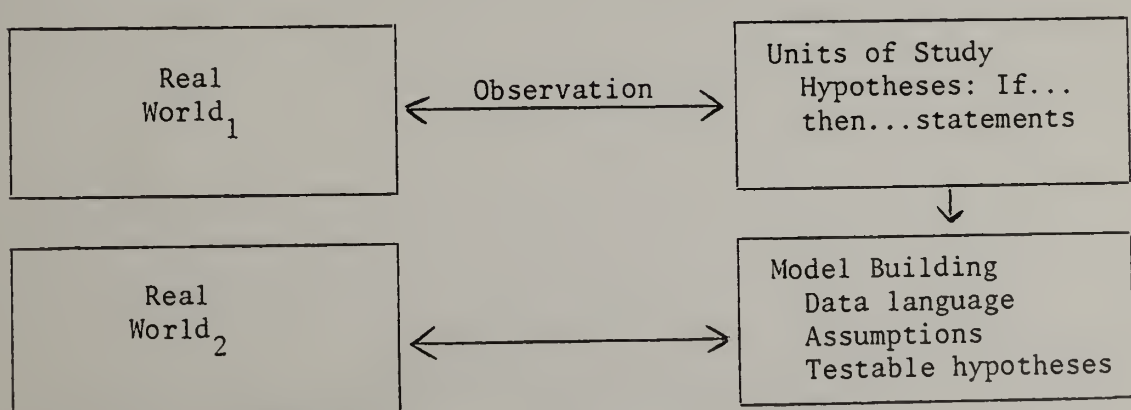


Figure 1. Scheme of Scientific Process

Observation

The first step begins with observations of the "real world." It is assumed that the real world exists or, as Einstein states, there is the "belief" that an external world exists. Observation involves an abstracting process that selects aspects of the "real world" for study. For our purposes, these can be referred to as units of study. The units of study for the physical sciences, for example, have been matter, space, time, energy, or, more generally, thing-thing interaction.

As psychology emerged as an empirical science, the basic units of study were organism-thing interaction as illustrated by Pavlov's theory of conditioning based upon the interaction of dogs and sounds; Skinner's respondent and operant conditioning theories were based upon examples of reinforcement schedules and rats pressing bars. Social psychology based its theories on organism-organism interaction, e.g., Harry Stack Sullivan's interpersonal theory of psychiatry. Sociological theories are based on organizational and institutional interactions as basic units of study. Arnold Toynbee, as an historian, held the field of historical study to be civilizations, which he used as the unit of study in developing his cyclincal theory of history.

In the observation process of abstracting units of study, a high degree of reductionism may be involved. The mechanistic paradigm for physics epitomizes this reductionism where the problem is decomposed into independent and dependent variables in search of linear causal effects. The classical prototype involves a probe, target, and neutral observer — cloud chamber. The degree of abstracting is so specialized that more than two atomic particles as units of study may be too difficult to handle experimentally. This degree of reduction may offer greater control and prediction which can be empirically verified; however, the level of explanation and understanding suffer. Thus, the view of the real world that results is somewhat analogous to the proverbial elephant and the five blind men.

What are the units of study upon which the Anisa Model is based? At the highest level of abstracting, the basic unit of study is change — the process of translating potentiality into actuality. This is the basic first principle underlying the Anisa theories. These energy transformations range from micro to macro units, i.e., the inanimate physical world to the biological, psychological, social, and spiritual units of study. Thus, it involves the physical, human and unknown environments including the self as both an object and subject. By analogy, it encompasses the totality of the proverbial elephant. Metaphorically speaking, it covers the forest, the trees, and the bushes. It handles the reductionist problem within a general theory of organization involving evolution and total cosmology. The terms comprehensive and coherent are, therefore, applicable to the Model.

Coherence means internal consistency, interconnectedness between conceptual units and the reduction of arbitrariness and fragmentation. Comprehension means scope, generality and ability to integrate and order diverse types of experience. The power and scope are so great as to qualify not only as a scientific but a metaphysical model as well. Metaphysical systems can be evaluated by criteria not unlike those used in judging scientific theories (Ferre, 1968). On the criterion of prediciton, however, metaphysical systems can not predict with the same degree of precision as scientific models because their categories are very general. It will be argued, nevertheless, that the Anisa theory can be empirically tested given the appropriate research methodology. The Anisa Model has been largely influenced by Whitehead and, in general, could be considered as a system of process metaphysics.

Model Building

Having established the unit(s) of study in the observation stage, the second step in assessing scientific theories is model building. There are a number of different kinds of models which serve diverse purposes (Barbour, 1974). First, experimental models which are constructed for laboratory use, e.g., scale models representing spatial relationships, wind-tunnel models for airplane design, analogue models, etc. They solve practical problems when experimentation with the primary system is impractical.

Logical models, which start from axioms and theorems of a formal deductive system, represent the second type of model. This model deals entirely in the realm of ideas; the formal system nor the model of it represent physical systems. Mathematical models, which are symbolic representations of quantitative variables in the physical or social systems, are a third type between the first two extremes. It is notable that the mathematical model resembles the primary system only in formal structure with no necessary material or physical similarities.

The focus of this chapter is the fourth kind, theoretical models. These models are imagined mental constructs invented to explain observed phenomena. Their primary function is to help understand the world, not necessarily to make preditions. Like a mathematical model, it is a symbolic representation but its intent is to represent the underlying structure of the real world. It is notable, as Korzybski pointed out, that the "word" is not the "thing" nor the "map" the "territory." A variety of symbol systems may be used, e.g., language, mathematics, or the arts.

In the process of theoretical model building, the following three components are necessary: (1) data language (precise definitional terms), (2) assumptions (implicit or explicit), and (3) the ability to generate new and testable hypotheses.

As early as the 1950's, the logical positivists (Bridgeman et al.) maintained that empirical science started with publicly observable data which could be described in pure, observation language. More recently, Kuhn (1970), Polanyi (1958), Hanson and others aruged that there is no neutral observation-language; and that all data are theory-laden. Kuhn particularly maintains that observational data and criteria for assessing theories are paradigm-dependent. A major paradigm shift, therefore, makes paradigms "incommensurable." Nagel (1961), Popper (1970) and others acknowledged two levels in science; a lower level of objective data describable in observation language upon which all observers can agree; and an upper level of theoretical constructs the result of man's creative imagination. Thus, the experimental empirical data provide the basis for testing predictions — a data base that would be common to all observers. A distinction was made between theory and observation.

As noted above, model building is a creative mental invention involving metaphorical, analogical and other cognitive processes. It is not merely inductively inferred from data. Even in modern physics, many theoretical entities are only very indirectly related to observations.

All theorists, nevertheless, in the process of theory building develop a data language defined as precisely as possible with concrete referents to the "real world." Feyerahend (1970) states, "Every theory has its own observation language. Consequently, comprehensive theories are incommensurable." Thus, in classical physics, the definitional terms of mass, motion, and time have a given meaning consistent with Newtonian theory. There was more than a semantic change in meaning of the definitional terms when viewed through Einstein's theory of relativity. Matter was an inherent and unchanging property of a body. The hyphenated term of matter-energy showing the equivalence of mass and energy in Einstein's famous equation of $E = mc^2$ indicates that terms do have different meanings according to a particular theoretical framework. The meaning of the term "atom" as conceived by Democritus was quite different from Dalton's use and most certainly from current meanings.

In the behavioral sciences, we frequently find similar units of study but the manner in which they are conceptualized differ, creating a seeming Tower of Babel. Psychology is characterized as representing a multiple paradigm science. For example, does the term ego as part of the data language of psychoanalytic theory refer to the same underlying process as H. S. Sullivan's interpersonal theory term of self-esteem or Carl Roger's term of self-concept? The data language used may differ but the underlying process may be the same.

Learning theorists use of the terms "stimulus" and "response" also pose similar problems. While terms such as stimulus may sound precise, it becomes very ambiguous when defined with concrete referents. A major problem in learning models is the need for a theory of the "stimulus." As will be discussed in Chapter II, the meaning of terms needs to be considered within the paradigm that is being used. Kuhn demonstrates the incommensurability of terms from one paradigm to another. Since the Anisa Model represents a paradigm shift, this issue should be confronted. Thus, the meaning of "time" as conceived in a process view of reality will significantly differ from the classical mechanistic concept of time. Time is not a Platonic entity where motion is a meausre of time but a process where time is a measure of motion. In reviewing the Anisa Model, or any scientific theory, it will be desirable to use the criterion of clear data language which is internally consistent with its respective paradigm.

The second step in model building is concerned with the assumptions underlying the theory. Are they made explicit? What are the implicit assumptions? As an example, again from physical theories, the shift in assumption by Einstein that the natural state of matter was in motion rather than at rest as Newton assumed resulted in a major paradigm shift. It required a new mathematical system to conceptualize the change and gave us a very different view of physical reality one that was able to handle the anomolies of Newton's system and yet incorporate his terrestial and celestial laws as special cases.

A more recent shift involved the Second Law of Thermodynamics which essentially states that in closed systems there is a degradation of energy, i.e., the system develops toward a randomization of molecules or a state of entropy. Information, communication, general systems, and cybernetic theories developed on the basis that aspects of the universe were not closed systems governed by entropy but open systems where negative entropy operates, i.e., a process that involves an organized complexity. This shift in assumption, it will be shown, may also contribute to a major paradigm shift.

Another example from the behavior sciences is the implicit assumption underlying the Skinnerian model that man is reactive to environmental influences. In contrast, other behavior theories assume that man is basically proactive, i.e., inherently active.

It will be shown that the Anisa Model fulfills this criterion of a scientific theory by making explicit its underlying assumptions. This is the keystone to the Model for it makes explicit its first principles. The change in assumption from the mechanistic efficient cause to an organismic assumption involving subjective aim and final cause is the basis for a major paradigm shift.

Testable Hypotheses

While data language and assumptions characterize most conceptual schemes including theological and philosophical systems, a good scientific theory fulfills the additional criterion of being able to generate new and testable hypotheses. This is the third step in model building. To qualify as a scientific theory, a model must have the capability of empirical testing in the real world. Up to this point, we were in theoretical "hunch land"; the bridge to the "land of verification" is accomplished by the generation of testable hypotheses. The theoretical model now permits us to view the "real world" through a new set of lens. It is open-ended and the cycle can repeat itself.

Whether science is cumulative as Popper claims or follows a revolutionary structure as Kuhn suggests, is not the issue here. The empirical testing of hypotheses in "if...then..." form with appropriate research designs is the crucial criterion for scientific respectability. It is the last step — testing hypotheses in the real world — that requires further clarification. Implicit in this step is the assumption that the growth of scientific knowledge follows a logical and rational process. Thus, the scientist moves from theoretical hunch land to the land of verification by designing experiments that can be empirically tested. If they are not verified, the theory is either abandoned, modified, or a new theory developed. Differences between competing theories are ultimately to be resolved by empirical testing. In simplified terms, this states the building-block or accretion concept of the growth of scientific knowledge. This view is consistent with the Newtonian mechanistic conception of science. While this chapter attempted to establish criteria for evaluating a scientific theory, there is serious question that the growth of the mature sciences actually follows this process of growth by accumulation. The Kuhnian framework will, therefore, be used in Chapter II as another perspective in evaluating scientific theories.

CHAPTER II

GROWTH OF SCIENTIFIC KNOWLEDGE

Kuhnian Perspective

The history of scientific growth as developed by Thomas Kuhn will be the framework that will be used to review scientific theories including the Anisa Model as representing a major paradigm. A brief overview of his structure of scientific revolutions with historical illustrations from the physical sciences will be the figure against which the Anisa development will be viewed. It is hoped that this procedure will not only place in clear figure-ground Anisa as the possible beginning of a paradigm for education, but the intelligent use of the insights of Kuhn's (1970) process cited in his Structure of Scientific Revolutions will prove helpful for those who may wish to toil within the Anisa paradigm.

One historical approach to the study of scientific development viewed it as a process of accretion. Science was the constellation of facts, theories, and methods described in textbooks from which each new scientific generation learns to practice its profession. Thus, scientific development was viewed as the piecemeal process of scientists contributing various elements to the constellation of scientific technique and knowledge. The historian, therefore, must determine what person at what time discovered or invented each scientific fact, law or theory.

Currently, historians of science question the concept of development-by-accumulation since it has become more difficult to answer such questions as: When was oxygen discovered? Who first conceived of energy conservation? In addition, the difficulty of differentiating the "scientific" component from what their predecessors had labeled "error" and "superstition" posed significant problems. The study of Aristotelian dynamics or phlogistic chemistry suggested, therefore, that those once current views of nature were neither less scientific nor more the invention of man than those current today. If the earlier beliefs were called myths, then myths can be created by the same methods that now lead to scientific knowledge. But if they are called science, then science has involved beliefs that are inconsistent with the ones held today. Therefore, out-of-date theories are not unscientific because they have been discarded. It raises a serious question that scientific growth is a process of accretion. Significant scientists from Francis Bacon to Karl Popper, nevertheless, hold the view of science as essentially a process of accretion.

A significantly different approach to the study of science has emerged. Kuhn makes explicit this changing image of science. Historians have now raised different questions concerning the developmental lines for the sciences. Instead of relating the contributions of an older science to the present, the historical integrity of the science in its own time was to be understood. Galileo's views were, for example, to be understood in relationship to his teachers, colleagues, and followers regarding their views and its fit to nature rather than the view held by current science. A pattern of development that characterizes the early stages of most sciences shows competition between a number of views of nature, all deduced and congenial to the rules of scientific observation and method. The schools did not differ in method but, in Kuhn's terms, "their incommensurable ways of seeing the world and practicing science in it." But there is an apparently arbitrary element, involving both personal and historical accident, that is found in the scientific beliefs held by the scientific community at a given time.

While the arbitrary factor is present, scientific groups practice their professions with sets of transmitted beliefs. Only after a scientific group believes it has clear answers to basic questions does significant research begin. Questions such as "What are the fundamental entities of which the universe is composed? What questions may legitimately be asked about such entities and what techniques should be employed in seeking solutions?" (Kuhn, 1970). The mature sciences have answers to such questions which serve as the basis for preparing students for practice. Training is rigorous and has a controlling effect on the scientific mind. Kuhn refers to this process as the basis of normal science wherein research is an attempt to fit nature into the framework provided by professional education. Scientific research probably could not continue without such conceptual frameworks.

Normal science proceeds on the assumption that the scientific group knows what the world is like. It defends this assumption and will suppress significant novelties because of its threat to the community's basic commitment. However, the arbitrary factor operating in normal research prevents the continued suppression of the novelty. Either a problem resists solution by known rules and procedures by the most competent members or new instrumentation fails to provide anticipated data emphasizing an anomaly that cannot be reconciled with scientific expectation. Normal science then faces a crisis which leads to extraordinary science. The anomaly which cannot be evaded threatens the existing scientific practice and forces the group to a new basis for scientific practice. Kuhn refers to these extraordinary episodes in which a paradigm shift occurs as scientific revolutions.

Illustrations of such episodes from the history of the physical sciences which represent major paradigm shifts are associated with Copernicus, Newton, Lavoisier, and Einstein. Each of these revolutions involved the rejection of an existing scientific theory for one incompatible with it. Each shift changed the standards by which the scientific community judged a legitimate problem or problem solution. There also resulted a change in world view within which science was practiced. Broadly these are the defining characteristics of scientific revolutions.

Kuhn's perspective representing the second historical approach to understanding the growth of scientific knowledge will be elaborated further with illustrations from both the physical and behavioral sciences as the background for determining whether the Anisa Model fulfills Kuhn's criteria of a scientific revolution and the implications for the growth of Anisa as a new paradigm.

Normal Science

Kuhn maintains that "normal science" means research rooted in scientific achievement that a scientific group recognizes as the foundation for its further practice. Scientific text books serve to communicate the accepted theory showing successful applications with exemplary observations and experiments. For example, Aristotle's Physica, Newton's Principia, Lavoisier's Chemistry served for a time to define legitimate problems and methods of research for a particular field for future practitioners to follow.

A scientific achievement that demonstrates the ability to (1) attract a group of adherents away from competing modes of scientific practice and (2) also be open-ended in defining puzzles for the new cohort of practitioners to solve are the two characteristics of what Kuhn refers to as a "paradigm". This is the basis for normal science. The accepted examples of scientific practice involving law, theory, application and instrumentation serve as the basis for a coherent research tradition. Copernican and Ptolemaic astronomy, Aristotelian and Newtonian dynamics are examples Kuhn uses of such practices. For Kuhn,

> The study of paradigms...is what mainly prepares the student for membership in the particular scientific community with which he will later practice. Because he joins men who learned the bases of their field from the same concrete models, his subsequent practice will seldom evoke overt disagreement over fundamentals. Men whose research is based on shared paradigms are committed to the same rules and standards of scientific practice. That commitment and apparent consensus it produces are prerequisite for normal science, i.e., for the genesis and continuation of a particular research tradition.(p. 11).

The concrete scientific achievement, which is the basis of professional commitment, precedes the laws, theories, and points of view that can be deduced from it. A discussion of normal science with examples of paradigms in operation is necessary for a better understanding of a paradigm.

Prior to the development of a paradigm there can exist a kind of scientific research. In the absence of a paradigm, the facts that may be relevant to the development of a science may all appear to be equally relevant. Early fact-gathering is focused on data that are readily available to casual observation. This kind of situation creates schools which characterize the early stages of the development of a science. Some implicit body of theoretical and methodological belief is necessary that determines selection, evaluation, and criticism in the collection of facts. Thus, in the early stages of scientific development, different men view the same range of phenomena and describe and interpret them in different ways. Such initial divergences disappear in the process of a developing science. This full disappearance is usually the result of one of the pre-paradigm schools whose beliefs and presuppositions then focuses on a particular aspect of a broad body of information. A new theory must appear better than its competitors to be accepted as a paradigm. The paradigm never necessarily explains all the facts with which it is confronted. It suggests experiments that would be worth performing. Both fact collection and theory clarification become highly directed operations. This kind of focus characterizes Francis Bacon's observation: "Truth emerges more readily from error than from confusion."

The current status of American education is characterized by these pre-paradigm processes. While some data gathering and research are conducted, they are more random operations resulting in theoretical schools. It is still at the philosophical and pre-paradigm stage.

The acknowledgement of the need for a comprehensive theory, nevertheless, is readily documented (Carney, 1977). Harold Rugg (1952) in the 1940's, commenting on the failure to use available new knowledge for teacher training observed, "It is a conception of wisdom, organized and focused, that we must now command. The cue is in the building of great theory...Only then can we organize our wisdom and provide the mature power to put it to work." In the absence of "great theory", we have theories whose units of study are development, learning, curriculum, etc. Theory within each of these domains, however, is considered to be inadequate. For example, in the area of human development, Mussen, Conger, and Kagan (1969) comment:

> There is no single comprehensive theory encompassing the vast body of accumulated data in the field of developmental psychology. A complete theory would have to include explanatory concepts accounting for the origins, as well as the mechanisms of development and change, of all aspects of psychological functioning — motor, cognitive, emotional, and social. It may be impossible to construct such an ideal theory; certainly no one has accomplished it yet(p. 16).

The field of curriculum appears to be at a comparable level. Goodlad (1958) makes the following observation:

> Nowhere in education is there greater need for a conceptual system to guide decision-making than in the field of curriculum. By conceptual I mean a carefully engineered framework that performs the following functions: identifies the major questions to be answered in developing any instructional program; reveals the elements that tie these questions together in a system and the elements that separate questions from one

> another; identifies them properly in relation to major questions; reveals the data-sources to be used in answering the questions posed by the system; and suggests the relevance of data extracted from these sources. The system must be an evolving one; new research findings should suggest orderly changes in the system itself...This is a tremendous burden of demands to be borne by a theoretical structure. But the burden is no greater than that carried by a scientific system. An education, like other sciences, must become scientific if it is to provide for the systematic solution of its own problems (pp. 391-92).

In the domain of learning, there is also the absence of a unified theory. In fact, the field could be characterized as consisting of learning theories almost identified by personal names, e.g., Hull, Miller, Skinner, Spence, etc. While there is a long history of research with a vast literature, markedly little theory has been available for application at the classroom level. Spence (1959), a learning theorist, states:

> ...those of us engaged in this endeavor have been under no illusions as to the applicability at the present time of our theoretical formulations to the practical problems of education. The fact of the matter is that we so-called learning theorists particularly those of us whose research has been conducted mostly with animal subjects have not been interested in the practical aspects of learning for many years (p. 85).

B. F. Skinner, who built his learning theory on organism-thing interaction using laboratory rats and pigeons, nevertheless, has become concerned with generalizing his findings to the classroom. The application of "laws of learning" derived from infrahuman subjects at the human level merely underscores the narrow range of theory development. In the desire to base educational practice on a scientific foundation, behavior modifiers apply operant and respondent conditioning techniques with children whether it fits reality or not. The limitations of this mechanistic science are addressed in Chapter III. Educational research and practices have relied heavily on the mechanistic paradigm primarily for educational evaluation purposes. But no science of education has emerged. The Anisa Model, with its presupposition as developed in the first principles, may prove to be a significant development in moving education to a new scientific paradigm status.

To illustrate this process, Kuhn traces the development of the science of physical optics. Current textbooks teach that light is photons, i.e., quantum-mechanical entities that demonstrate characteristics of both waves and particles. Research is conducted on this basis. This half century old concept of light developed by Planck, Einstein et al. was preceded by a paradigm that held that light was transverse wave motion. The eighteenth century paradigm was related to Newton's view that light was material corpuscles. These paradigm changes in physical optics are scientific revolutions, according to Kuhn. This is the pattern of development of mature science — transition from one paradigm by revolution.

The pattern before Newton, however, was quite different. In this early period, there was no generally accepted single concept about the nature of light. There was a number of competing schools based upon different metaphysical systems (e.g., Aristotle, Plato). Some held light to be particles emanating from material bodies or a modification of the medium between the material body and the eye, or an interaction of the medium with an emanation from the eye. Each school contributed concepts or techniques upon which Newton developed the first uniformly accepted paradigm for physical optics. The creative men of the various schools were, nevertheless, scientists. However, practitioners of physical optics before Newton were scientists but the effects of their studies were something less than science. Kuhn further states:

> Being able to take no common body of belief for granted, each writer on physical optics felt forced to build his field anew from its foundations. In doing so, his choice of supporting observation and experiment was relatively free, for there was no standard set of methods or of phenomena that every optical writer felt forced to employ and explain. Under these circumstances, the dialogue of the resulting books was often directed as much to the members of other schools as it was to nature (p. 13).

This pattern is analogous to a number of creative fields in the behavioral sciences and it exemplifies the field of education in particular. There appears to be a direct parallel between Newton's contribution for creating a paradigm for the field of physical optics and Jordan's contribution for creating a paradigm for the field of education. Jordan's first principle underlying the Anisa theory serves that function. It can serve as the unifying belief that is the basis of a new paradigm for education. In Kuhn's historical perspective, therefore, the Anisa Model moves education out of its pre-scientific stage to a paradigm status. This is the first and necessary step in the route to normal science.

Paradigms and Normal Science

Normal science, according to Kuhn, consists of work conducted within a paradigm which determines the legitimate research approaches to be used. Some accepted examples of actual scientific practice — examples which include law, theory, application and instrumentation together — provide models from which spring particular coherent traditions of scientific research. A paradigm is not usually replicated; it is more analogous to a judicial decision in common law which calls for further articulation and specification under more stringent conditions. Paradigms become accepted because they solve some problems that a group believes to be important better than previous paradigms. The success of a paradigm at its beginnings is essentially a hope of success discoverable in selected and still incomplete examples. Normal science consists of the actualization of that hope and expectation. This is actualized by dealing with three problems — determining what are the significant facts, matching fact with theory, and further articulation of theory.

The acceptance of a new paradigm leaves a great deal of mopping-up work. These mopping-up operations engage scientists throughout their careers. Normal science consists of solving those legitimate problems posed by the paradigm by essentially forcing nature into the new boxes that the new paradigm supplies. Normal science does not focus on new phenomena; those that don't fit the existing boxes are usually ignored. The goal is not the invention of new theories; in fact, there is a high intolerance of those who do.

The outcome of this process of normal science is the solution to problems which usually prove to be permanent achievements. Normal sciences focus the attention of scientists on a small range of problems determined by the paradigm through investigation of some part of nature in great detail and length. Without commitment to the paradigm, these problems would not have been imagined nor work undertaken. This heavy commitment and focus change when the paradigm from which they were derived does not function effectively. Science then faces a crisis and moves into what Kuhn refers to as extraordinary science.

What are the parallels of this normal science development to the Anisa paradigm? The mechanistic paradigm has dominated both the physical and the behavioral sciences and particularly educational research by determining the kinds of problems that could be solved and forcing them into its conceptual boxes. Significant achievements have been documented. Newton's contribution to the physical sciences, which essentially established the mechanistic paradigm, epitomizes its lasting and significant achievements.

The behavioral sciences, particularly psychology which has greatly influenced educational practices, have largely modeled their "science" on the mechanistic paradigm. The research methodology generally accepted in the educational field relies on the demonstrative strategy. We deal methodologically with operationally defined givens and the theories accept only validated facts which are removed by a step from the data under study. The design purposely removes us from the experimental procedure. This extraspective theory formulation is written from the vantage point of an observer with the ideal of being able to do so without any contact with the items (students) under study. This traditional, "natural science" approach is based on the Lockean-Newtonian paradigm. The classic experimental designs, as presented by Campbell and Stanley (1966), serve as the legitimate procedures for acceptable research in the professional journals and texts.

The influence of the mechanistic paradigm has dominated research and evaluation in educational practice. This has been its primary impact wherein education could lay claim to being a science functioning under a paradigm. It is quite different, however, from a science of education that is the basis for all educational practices not merely evaluation. Efforts in this direction have been undertaken. For example, the learning theory of B. F. Skinner has been systematically applied, particularly in special education, with some degree of success. It is notable that Skinner based his theory on the mechanistic paradigm and its general acceptance within the behavioral science community is based on their commitment to this paradigm. While it is being used as the substantive body of knowledge for applied educational practice, it covers a relatively narrow range of educational practice. This is comparable to the narrow range of legitimate problems that were solved in his research efforts with infrahuman subjects. Skinner's significant scientific contribution is his exemplar of the "Skinner box" used in his experiment with rats learning to respond to different reinforcement schedules (independent variable) contingent on pressing a bar (dependent variable). Generalization of this very productive scientific achievement (exemplar) to the human level in education has, however, created awareness of a number of anomalies.

It is notable that the field of educational practice, in general, can still be considered to be at the philosophical or pre-paradigm stage according to Kuhn. Some small islands of practice can be found that can be considered scientific and based on the mechanistic paradigm. If the Anisa theory qualifies as a new paradigm, therefore, it would move these small educational islands of practice to a dual paradigm science.

There are three areas of overlapping concern for scientific investigation. The first concerns the category of facts that the paradigm illuminates as revealing of the nature of things. These are used in puzzle-solving which the paradigm has determined as important to study with greater precision. Kuhn illustrates this with examples from physics — specific gravities of materials, wave lengths and spectral intensities, electrical conductivities and contact potentials. Great effort is expended to increase the accuracy and scope with which such facts occupy the literature of experimental and observational science. Much of the best scientific talent is devoted to designing special apparatus for these purposes. Synchrotrons and radiotelescopes are examples of the extent of funds and effort that scientists will expend if a paradigm assures them that the facts they seek are important. Great reputations have been made from the accuracy, reliability and scope of the methods developed concerning some facts and not from new discoveries. The fleshing out of the Anisa paradigm, therefore, suggests a similar process. The study of the patterned use of energy in the release of both the biological and psychological potentialities are areas of factual concern. The development of instrumentation and methods to accomplish this will entail much effort and occupy many creative workers.

The second area of factual determinations is related to facts that can be compared directly with predictions from the paradigm theory. Kuhn notes that there are few areas in which a scientific theory — particularly developed in mathematical form — can be compared directly with nature. For Einstein's general theory of relativity there still are only five areas that are currently verifiable. These check points are related to the precision of Mercury's perihelian, the red shift in the spectrum of light from distant stars, and the bending of light around the sun. However, measurements on the latter are considered equivocal. In addition, Joseph H. Taylor et al, (1979) of the University of Massachusetts at Amherst provided the first test of Einstein's general theory of gravitation to be made on objects outside the solar system. This test was made possible by the discovery in 1974 of a radio pulsar that is a member of a binary pair. Since the pulsar emissions can be timed with high precision, it provided another opportunity for testing theory predictions never before accessible.

Even where application of theory is possible, theoretical and instrumental approximations frequently limit the degree of agreement expected. Improving or finding new areas of agreement that can be demonstrated occupies some of the best talents. Telescopes were necessary to demonstrate some of the Copernican predictions. The great scintillation counter was designed to show the existence of a neutrino. These merely illustrate the effort and talent that are required to bring nature and theory into agreement. The paradigm sets the problems to be solved, and it is the type of experimental work to demonstrate agreement between theory and nature that characterizes this phase of normal science.

As the Anisa paradigm develops, we can anticipate that the ingenuity of its workers will deal with similar problems. For example, considerable talent will be required to develop the instrumentation necessary to demonstrate agreement between the Anisa theory concerning cognitive structures (hypothetical constructs) and their referents in the brain or brain functioning. Some work with rats mapping cognitive spatial relationships have been already demonstrated using electrodes implanted within nerve cells. The instrumentation that will need to be designed to demonstrate agreement of theory with these mental processes in nature will require both talent and effort. The theory, nevertheless, has posed the problem. While it may prove to be more complex and difficult to solve, it can be compared to Dr. Harvey having to wait for the microscope as the needed instrumentation to demonstrate the existence of capillaries to provide the empirical evidence for his theory of the circulation of blood in the body.

The third set of experiments and observations that are concerned with the fact-gathering activities of normal science are those undertaken to articulate the paradigm theory. These focus on resolving problems where there are ambiguities. Much of this work in the physical sciences is concerned with experimentation directed at determining physical constants. In Newton's work, the universal gravitational constant that the force between two unit masses at unit distance would be the same for all types of matter in the universe is an example. Parallel issues will occupy the normal science phase for Anisa. For example, the first principle underlying the theory is the universal constant of "change" itself. Another problem of concern deals with the invariance of the stages of human development.

Universal constants are only one area of further articulating the paradigm. The development of quantitative laws is another important activity. Kuhn cites Boyle's Law regulating gas pressure to volume and Joule's formula relating heat generated to electrical resistance and current. It is significant that a paradigm was a prerequisite to the discovery of these laws for they were not merely found by examining measurements without a theoretical commitment. There appears to be a close relationship between qualitative paradigm and quantitative law such that some laws have been correctly deduced with the aid of a paradigm long before apparatus was designed for their experimental determination.

Statistical laws, particularly those related to Fisher's Unit Normal Curve and the assumption of random distribution of a trait in the population, have dominated the mechanistic paradigm of some behavioral sciences. While these are subsumed under the Anisa framework, the need to develop quantitiative laws for measuring change (development) over time is articulated by the theory and provides the focus for needed work.

Theoretical problems of normal science are concerned with using existing theory to predict facts of intrinsic value. Computation of lens characteristics or the production of radio propagation curves are examples Kuhn cites. These are regarded as hack work conducted by engineers. Their purpose is to show new applications of the paradigm and increase the precision of applications

This work is very needed for it is difficult to find points of contact between a theory and nature — bridges from theoretical hunch land to the land of verification are difficult to build. Kuhn illustrates this by examining the history of dynamics after Newton. The paradigm found in his Principia, for the first time, permitted a great increase in scope and precision of research. Newton derived Kepler's Law of planetary motion and made observations on pendulums and tides. These were impressive considering the state of science then. Given the generality of Newton's laws, however, the number of applications were limited and had only limited precision. Most were for celestial mechanics with problems adapting them to terrestial applications. The degree of precision achieved left much to be desired. Large approximations existed between Newton's predictions and actual experiments. Quantitative telescopic observations indicated that planets did not obey Kepler's Laws as Newton predicted. However, Newton derived them by neglecting all gravitational attraction except that between individual planets and the sun. Because planets attract each other, only approximate agreement between theory and telescopic observation could be expected. The theory was generally satisfactory and few questioned the validity of Newton's theory because of the limited agreement with observation. These limitations in agreement left many theoretical problems for Newton's successors to solve. Problems of dealing with the motions of more than two simultaneously attracting bodies occupied the best mathematicians for two centuries, e.g., Laplace, Ealer, Gaus, and others. This is an example of the post-paradigm period where fundamental laws became fully quantitative with most of the theoretical work having a mathematical base. These examples from the mature physical sciences are suggestive of the kinds of problems one can anticipate as a consequence of developing a new paradigm.

Normal Science and Puzzle-solving

The aim of normal science is not to produce major novelties; the goal is paradigm articulation. The results of normal research are significant because they add to the scope and precision of the paradigm. The enthusiasm that scientists show in bringing a normal research problem to a conclusion is in achieving the anticipated in a new way which requires the solution to complex instrumental, conceptual and mathematical puzzles. The scientist who succeeds in responding to the challenge of the puzzle proves himself an expert puzzle-solver and this is a prime source of motivation.

Kuhn uses the term "puzzle" and "puzzle-solver" to mean problems that can serve to test ingenuity or skill in solution by the "puzzle-solver". Puzzles share the same characteristics of problems in normal science. A paradigm sets the criterion for a scientific community in selecting problems (puzzles) that are assumed to have solutions. In fact, these are the basic problems that are admitted as scientific and encouraged to be undertaken. The paradigm can even serve to isolate members from important problems that are not reducible to puzzle form if they cannot be formulated within the conceptual and instrumental tools that the paradigm provides.

It is evident why the puzzles of normal science are attacked with great commitments. Many of the greatest scientific minds have devoted their lives to demanding puzzles. If a problem of normal science is to qualify as a puzzle, it must be assured of a solution according to rules delimiting the steps used in obtaining the solution. The scientist who builds an instrument to determine optical wave lengths must show that the numbers on his instrument are the ones that enter theory as wave lengths; otherwise, he is merely an explorer or measurer.

Other examples of restriction on acceptable solutions to theoretical problems concerned difficulties scientists had in deriving the observed motion of the moon from Newton's laws of motion and gravitation which consistently failed. Suggestions for replacing the inverse square law were made but that would have changed the paradigm requiring a new puzzle without solving the old. The rules were preserved and a solution was finally discovered. Newton's laws helped set puzzles and to limit acceptable solutions. Quantity-of-matter was fundamental and the forces that act between units of matter dominated research. In chemistry, the laws of definite proportions and, currently, laws of statistical thermodynamics serve the same function.

Kuhn also notes that to be a scientist, there is a commitment to understand the world and extend the precision and scope with which it has been ordered. A network of commitments — conceptual, instrumental, and methodological — is the metaphor that relates normal science to puzzle-solving. It provides the rules that tell the practitioner what both the world and his science are like. While normal science is a highly determined activity largely governed by rules, it is notable that the rules are derived from paradigms and paradigms can determine research in the absence of rules.

The following are illustrations of puzzle-solving that face Anisa scientists in its normal science phase. As a new paradigm, it will be necessary to deal with measurement of longitudinal change in the development of the individual and social systems. Under the mechanistic paradigm, educational measurement — highly influenced by psychology — solved the problem of individual measurement by developing normative tests. The solution to the puzzle form was based on the assumption that given traits, e.g., intelligence, achievement, etc. were randomly distributed in the population. Using Fisher's statistics of the Unit Normal Curve, psychometric procedures were developed for measuring a given characteristic in the population. Binet developed items that he considered as constituting a constellation of intelligence and administered these to a random sample of children at various age levels. In simplified terms, these data were then handled statistically using the normal distribution. Intelligence was then operationally defined using objective procedures somewhat analogous to the development of the thermometer for objectively measuring temperature. Psychometric procedures have since been refined for reliability, validity, test construction, etc. The problem of measurement of individual growth was a puzzle that was solved with a highly sophisticated set of rules that has occupied many creative behavioral scientists for the last three quarters of a century.

The organismic view held by the Anisa theory is not only concerned with cross-sectional studies based on the assumption of random distribution but concerned with longitudinal studies of the individual based on the assumption of an organized complexity. This problem needs to be solved — the paradigm sets the problem. This is a major problem posed by the Anisa theory of development in its ontological and phylogentic form. New mathematical systems with related measuring technology are necessary components for puzzle-solving. It will be one criterion of determining the viability of Anisa as a new paradigm. Chapter III will elaborate this problem when dealing with the implication for the Anisa theory of evaluation.

Since the Anisa Model is concerned with the capacity for perpetual ontological and phylogenetic emergence, the problem of how to measure the emergence of organized complexities needs to be solved. Stated in simpler form, we need to understand the "more" in the concept of the whole being equal to "more" than the sum of its parts. The mechanistic paradigm had its major focus understanding nature by the reductionist position of analyzing the cause and effect relationship of component parts. The crisis in biology is related to the best talents devoting their efforts to studying DNA and RNA as basis for understanding evolutionary processes without a concomitant focus on a general theory of organization related to variation and natural selection. As Jordan states, it tends to be governed by Western thought of also looking at the past — the rear view mirror analogy. When looking at the future — through the windshield — and creating new social structures, the problems posed are even more complex. However, research programs at the physical level have demonstrated conceptual and technical approaches to solving this puzzle. The concept of synergy, as developed by Buckminster Fuller (1975), concerns behavior of whole systems unpredicted by the behavior of their parts taken separately.

Fuller demonstrates this by metals increasing their strength by a synergetic process. For example, in chrome-nickel-steel alloys, the constituents are iron, chromium, and nickel with minor components of carbon and manganese. The tensile strength of iron is about 60,000 pounds per square inch (p.s.i.); chromium is about 70,000 p.s.i.; nickel is about 80,000 p.s.i.; carbon and the other minor constituents are another 50,000 p.s.i. These all add up to 260,000 p.s.i. However, the tensile strength of chrome-nickel-steel is about 350,000 p.s.i. Here, the behavior of the whole is totally unpredicted by the behavior of the parts. This high cohesive strength and stability at great temperatures of this alloy made possible the jet engine.

This is an empirical physical example of the whole being equal to more than the sum of the parts. The synergistic concept has been demonstrated in biological medicine and was used early by Ruth Benedict in anthropology.

Anisa, if it is to develop as a new paradigm, will pose the legitimate research problems that can be converted into puzzle form that permit a solution governed by a set of rules.

Anomalies: Basis for Scientific Discoveries and Inventions

Kuhn holds that the puzzle-solving activities of normal science provide for the expansion of scope and precision of scientific knowledge. These activities do not seek novelty; the successful science finds none. New discoveries of fact by routine scientific research, nevertheless, give rise to new inventions of theory to deal with the novelties. Research under a paradigm, therefore, has a built-in process for effectively creating a paradigm change. Discovery begins with the awareness of anomaly which comes when it is acknowledged that nature is violating a paradigm-induced expectation. The anomaly is further explored and closure results when the paradigm theory has been adjusted so that the anomaly becomes the expected. Kuhn maintains, however, that this assimilation process is not additive and the new fact is not a scientific fact until science is able to see nature in a different way. Anomalies are set to one side or accomodations are made by ad hoc modifications. For example, phlogistan theory requires a postulation of negative chemical weights in order to maintain the paradigm; astronomy under Ptolemy kept adding epicycles to remove discrepancies. A growing list of anomalies creates a sense of crisis causing the scientific community to examine its assumptions and seek alternatives. When the dominant presuppositions are challenged by an alternative view, a new paradigm may then be invented.

Kuhn illustrates the process of how factual and theoretical novelty are interrelated in the discovery of oxygen. Two men, Lavoisier and Joseph Priestly, have some claim to it. Priestly, in 1774,collected gas released from heated red oxide of mercury. He identified the gas as nitrous oxide, and in 1775, following additional tests, called it common air with less than the usual quantity of phlogistan. Lavoisier's work followed closely after and in 1775, the gas he obtained by heating red oxide of mercury was "air itself entire without alteration except that.. it comes out more pure, more respirable." By 1777, Lavoisier believed that the gas was a separate species, something that Priestly could not accept.

It is very difficult to credit either Lavoisier or Priestly with the discovery of oxygen. The pattern of scientific discovery is necessarily complex which requires the recognition both that something exists and what it is. Thus, if oxygen were dephlogisticated air, Priestly would be given credit, but it was Lavoisier who identified the gas as "air itself entire" suggesting that he saw not only the gas but what it was. The discovery process of observation and conceptualization are intertwined and take time.

This process may involve a change in paradigm. Lavoisier's work was not only the discovery of oxygen but the "oxygen theory of combustion". This theory was the basis for the reformulation of chemistry taking on the significance of the "chemical revolution". Lavoisier believed that something was also wrong with the phlogistan theory and that burning matter absorbed part of the atmosphere. Thus, he had the awareness that something was amiss and was readied to discover the nature of the substance that combustion removes from the atomosphere. This preceeded his discovery of the new gas. It played a significant part in the emergence of a new paradigm for chemistry. A major paradigm revision was required in order to see what Lavoisier saw; Priestly was unable to see it at all.

Another example of discovery is Roentgen's normal investigation with cathode rays wherein he noticed a glow on a barium platinocyanide screen some distance from the shielded apparatus. The discovery was through accident. He saw that the glow came in straight lines, could be deflected by a magnet, etc., and that it was not due to cathode rays. This process is similar to the discovery of oxygen for Lavoisier had performed experiments that did not give the results expected under the phlogistan paradigm. Roentgen recognized that the screen glowed, when according to the prevailing theory, it should not. He saw a phenomenon which his paradigm had not readied him to see. The perceived fact that something had gone wrong set the stage for discovery. Thus, the discovery of X-rays emerged which followed a similar process of experimentation and theoretical assimilation as did oxygen.

In general, Kuhn believes the development of any science proceeds on the basis that the first received paradigm successfully accounts for most of the observations and experiments easily available to its practitioners. Continued development involves the construction of elaborate equipment, creation of a precise data language, techniques, and further conceptual clarity. This professionalization restricts the scientists views resulting in considerable resistance to change. However, the paradigm directs the attention of the group and results in precise data from matching observation and theory. The special apparatus helps to focus on the anticipated functions, and when novelty does occur, it happens when the scientist knows with precision what to expect by knowing what went wrong. Thus, anomaly develops against the framework provided by the paradigm.

Since education is at the pre-paradigm stage, this process of the growth of the mature sciences does not appear to apply. In the absence of a paradigm, how does one recognize an "anomaly" from a difference in theoretical school? Where education has, however, been influenced by empirical science, e.g., educational research, it has been dominated by the Lockian-Newtonian mechanistic paradigm. This study will identify a number of anomalies, e.g., unidirectional vs. reciprocal causality, holism vs. elementarism, etc. These anomalies appear against the background of the mechanistic paradigm as applied to education. These discoveries contribute to paradigm change leading to a crisis. Discovery of anomalies tend not only to be destructive of a paradigm, but set the stage for the construction of a new paradigm which can assimilate the anomalies and account for a wider range of phenomena.

The continued presence of anomalies poses a crisis for the science and is the source of both the destruction of the paradigm and the construction of a new one. The single discoveries of Roentgen and Lavoisier, noted above, are not the only pattern for paradigm shifts. Discovery of anomalies and their final theoretical assimilation into a new paradigm may involve a long period of time. For example, the Ptolemaic system developed before Christ was very successful in predicting the changing positions of stars and planets and is still useful today. A number of discrepancies were noted through the centuries but it was not until the sixteenth century that Copernicus rejected Ptolemy's paradigm as he searched for a new one. It was not only the breakdown of the technical puzzle-solving activities of astronomers, but social pressures for calendar reform and other historical events. The Copernican revolution in astronomy, i.e., the change from a geocentric to a heliocentric view, is a classic example of Kuhn's concept of a paradigm shift. The change in perspective is dramatic. Other notable examples are the Newtonian and the Einsteinian revolutions.

Kuhn raises the question of how scientists respond to prolonged confrontation to anomalies. The evidence suggests that while there may be a loss of faith in consideration of an alternative, scientists do not renounce the paradigm that led to the crisis. The anomalies are not seen as counterinstances of falsification by direct comparison with nature. The historical study of scientific development does not support the Baconian or Popperian view. While there is rejection of scientific theory by observation and experiment, the process of judgment is based not only on the comparison of theory with nature but also with the concurrent decision to accept another paradigm. Thus, it involves a comparison of the competing paradigms with nature as well as between the paradigms themselves.

Counterinstances have, historical evidence suggests, been handled by scientists by creating ad hoc modifications of theory to eliminate conflict. All research involves some degree of counterinstances but the paradigm determines the way in which these are perceived. What Copernicus perceived as counterinstances were seen as puzzles solved under Ptolemy's system. Some give up science because the crisis becomes so great. Kuhn states:

> Once a first paradigm through which to view nature has been found, there is no such thing as research in the absence of any prardigm. To reject one paradigm without simultaneously submitting another is to reject science itself. That act reflects not on the paradigm but on the man. Inevitably, he will be seen by his colleagues as the carpenter who blames his tools (p. 79).

Dealing with anomalies leads to crisis and this transition begins what Kuhn calls extraordinary science — outside of the ordinary. More attention by the most competent scientists is given to its resolution. The problems are attacked but remain resistant to the existing paradigm rules. Einstein's observation of this process is characterized by his statement, "It was as if the ground has been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built."

The crisis leads to a breakdown which is resolved in one of three ways. First, there is a blurring of the paradigm and the loosening of the rules of normal research. Research in this stage parallels research in the pre-paradigm period. This is quite characteristic of current educational research under the mechanistic paradigm. Second, if no solution seems possible, the problem is identified for solution by future generations. Third, the crisis may have closure with the emergence of a new paradigm with the concomitant battle over its acceptance. Anisa appears to represent this third resolution to a crisis. The transition from a crisis of a paradigm to a new one with a new transition of normal science is not a cumulative process. It involves a reconstruction of a field from new fundamentals that changes the field's primary theoretical generalizations. Jordan's reconstruction of the field based upon his first principle of change constituting process as reality sets the new fundamentals for an organismic paradigm.

Just how this process of invention unfolds is not clear. However, the shape of a new paradigm may be "seen" before the new paradigm emerges. Einstein observed that before he had a substitute for Newtonian mechanics he was aware of the relationships between a number of anomalies and his final solution. New paradigms may also emerge in the middle of the night by a scientist who is involved in the crisis. Usually, the men who do invent a new paradigm are either very young or new to the field. Kuhn notes that these men are not fully committed to the traditional rules and are freer to conceive of another set. This transition to a new paradigm is a scientific revolution.

Daniel Jordan appears to follow this latter pattern. He entered the scientific field following a career in the arts — music. His formal training also assumed an interdisciplinary approach involving both the physical and the behavioral sciences. This is what C. P. Snow referred to as two cultures. This perspective and his relative youth parallel the usual pattern of men who have been at the forefront of creating a new paradigm. Thus, it is not only a new scientific paradigm but unique in its application to education by moving the field out of its pre-scientific philosophical stage.

Kuhn's framework was used for explaining the growth of scientific knowledge with illustrations from the physical sciences to demonstrate parallels with my claim that the Anisa theories represent a new paradigm when judged within the Kuhnian perspective. Anisa, as a paradigm, offers a general theoretical system capable of incorporating a wide range of phenomena including the essential nature of reality, including man. This moves education out of its pre-paradigm stage. As noted above, education as a science was primarily influenced — particularly educational research — by the Newtonian mechanistic paradigm. This paradigm will be elaborated further to illustrate not only its significant contributions but a number of anomalies that have been discovered in both the physical and behavioral sciences. This process will serve to clarify the role that the Anisa theories play in theoretically assimilating these anomalies which has led Daniel Jordan to invent, in essence, a new paradigm. His dealing with these anomalies, it is my thesis, results in a shift from a mechanistic to an organismic paradigm.

Historically, the mechanistic-deterministic paradigm has its origins with John Locke, the British empiricist philosopher, and most important for scientific application was Newton. This has been covered in depth in other sources (Matson, 1964; Reese and Overton, 1970; Schan, 1963). Kuhn's scheme of scientific revolutions (Loevinger, 1978) applied to the mechanistic paradigm with two substantive theories will be used to illustrate briefly the process. Aspects of both Newton's and Skinner's theories representing the physical and behavioral sciences will illustrate the paradigm application.

CHAPTER III

SCHEME OF SCIENTIFIC REVOLUTIONS

According to Kuhn, therefore, a scientific paradigm begins with a great discovery, frequently announced in a book. Underlying this grand discovery is a presupposition(s), sometimes explicitly stated; often it is implicit until the paradigm as a whole is challenged. A consequence of the paradigmatic discovery is the development of a general theoretical matrix; this, in turn, gives rise to a method that is the basis for further discovery and articulation of theory into new areas. The paradigm defines its own data and legitimizes some data that were not previously acceptable for "scientific" study. The method generates new applications that, in turn, will solve new puzzles. This process of puzzle-solving continues until a number of unsolved puzzles or theoretical anomalies are discovered that then creates a crisis for the scientists working with the paradigm. This gives rise to "extra-ordinary science" where some scientist will make a new discovery that resolves the crisis and creates a new paradigm. The resulting paradigm shift represents what Kuhn calls a scientific revolution. This brief summary is further illustrated in Figure 2.

This chapter will present the application of this scheme for the mechanistic and organismic paradigms. Newton's and Einstein's theories will be used to exemplify the process applied to these mature physical sciences. Illustrations from mechanistic science — both physical and behavioral — leading to the paradigm shift will be made. The scheme will then be illustrated, demonstrating how Anisa as a paradigm deals with the anomalies leading to a new organismic paradigm for education.

Presuppositions underlie		Grand Discovery			
			turned into	Method	
			and leading to	Theory	
			and	Assimilation of Old Facts	
generate	New Applications				
and	New Small Discoveries				
and	Anomalies				
and	Theoretical Crisis	lead to new	Grand Discovery		

Figure 2. Scheme of Scientific Revolutions (after Kuhn, 1962; Loevinger, 1978)

The Mechanistic Paradigm

Presuppositions. The basic metaphor of the mechanistic paradigm is the machine, i.e., the lever or computer. For Newton, it was the study of matter in motion resulting in the machine model of the universe. Primarily, efficient cause, which must be external force, served as the explanatory scheme. Chainlike cause-and-effect linear sequences operate in nature. Complete predictions and control are therefore possible since knowledge of the forces to be applied to the state of the machine at one point in time permits prediction of the state at the next.

Grand discovery. Paradigms, Kuhn maintains, are shared exemplars. Newton's Second Law of Motion, for example, is a widely shared exemplar which is written as f = m x a. The student of science learns to identify forces, masses, and accelerations in a variety of situations. A great deal of "tacit knowledge", as Polanyi characterizes it, is present in the process. Kuhn cites the following variation on f = m x a when applied to a body in free fall:

$$mg=m\frac{d^2s}{dt^2} \quad \text{or simple pendlum to} \quad mg\ \sin = -ml\ \frac{d^2}{dt^2}.$$

Method. Parts of the universal machine are inherently at rest and active only as a result of external forces — efficient causes. Newton was concerned with methods of understanding matter in motion. Efficient causes are external to any system under study and method is related to identifying efficient cause-and-effect relationships. There is a unidirectionality of cause and effect. A linear relationship exists between efficient causes and effects. Thus, the basic research method involves breaking the problem down into independent and dependent variables. This reduction or elementarism of the mechanistic paradigm assumes that the machine represents a collection of elements where the whole is predictable from its parts and physically identical elements are equivalent.

Theory. Newton in his Principia laid down the theoretical laws for matter in motion. Thus, for example, his First Law of Motion (or Law of Inertia) states: "A body remains at rest, or if already in motion, remains in uniform motion with constant speed in a straight line, unless it is acted on by an unbalanced external force." (Asimov, 1966).

Newton's Second Law of Motion, which could also be considered as the exemplar of the paradigm, states that force is equal to the product of mass and acceleration ($f = m \times a$). His Third Law of Motion states that for every action there is an equal and opposite reaction.

This theoretical framework served as the basis for both his terrestial and celestial laws and are valid today for matter moving at speeds less than the speed of light. They gave rise to highly successful research programs and serve as the basis for the applied science of engineering.

Assimilation of old "facts". Newton's theory was a significant break from Aristotlian dynamics. Even before Newton was born, there was a rejection of Aristotlian and scholastic explanations expressed in terms of the essences of material bodies. A stone fell because its "nature" drove it toward the center of the universe. Henceforth, sensory appearances — (e.g., color, taste) were explained in terms of the size, shape, position, and motion of the elementary corpuscles of base matter and the attribution of other qualities to atoms resorted to the occult and was considered out of bounds for science. The mechanico-corpuscular view of nature directed scientific attention to new subjects of study. Newton's dynamics expressed in his three laws of motion reinterpreted well-known observations in terms of the motions and interactions of primary neutral corpuscles. While the corpuscular paradigm bred new problems and their solution derived from the mechanico-corpuscular view, Newton still had to interpret gravity as an innate attraction between every pair of particles of matter which retained as much an occult quality as Aristotle's "tendency to fall". Although troubled, the scientists working within standards of practice set forth in Newton's Principia, nevertheless, accepted the view that gravity was innate. Innate attractions and repulsions were irreducible primary properties of matter. While, on this dimension, it would appear that there was a revision to Aristotlian standards, the explanation of the old facts were assimilated within a new conceptual scheme.

Generate new applications. The mechanistic world view has been the basis for theory development in a number of areas of inquiry. In the behavioral sciences, particularly psychology and education, the result is the reactive organism model of man (i.e., man is reactive to external efficient causes). The learning theory of B. F. Skinner epitomizes this approach. The rat receiving reinforcement contingent upon pressing a bar ("Skinner box") can be considered the exemplar of this behavioral science. The research methodology involves isolating the independent (reinforcement schedule) and dependent (bar pressing) variables and studying these under controlled conditions. Objective learning curves were the result. Skinner referred only to objective observable behavior. The "empty organism" or "black box" analogy characterizes the degree of objectivity involved that made this empirical approach legitimate science under the mechanistic paradigm. The implicit learning of those who underwent such laboratory experiences were generalized to application at the human level. Although the units of study changed, i.e., organism-thing to organism-organism interaction, application of the method has been applied at the human level, particularly in the education of exceptional children.

In its ideal form the reactive-organism model, analogous to other parts of the universal machine, is inherently at rest and active only as a result of external forces (stimuli functioning as efficient causes). Hypothetical constructs such as thinking and willing are also viewed as phenomena that can ultimately be reduced to more simple data governed by efficient causes. The emergence of novelty — or qualitative change — is an epiphenomenon which can also be reduced to quantitative change.

New applications were also made to education. The classical physics research design, i.e., a probe, target, and neutral observer (cloud chamber), served as a prototype for educational research. The educational problem was decomposed into independent and dependent variables. If this was not possible, it was not a legitimate scientific problem. Research designs were created to obtain objective data largely excluding the observer or participant observer to insure maximum objectivity. The experimental designs articulated by Stanley and Campbell (1966) serve as the legitimate puzzle-solving rules of the mechanistic paradigm applied to education and the behavioral sciences.

Whether the design involved Latin Squares, analysis of covariance, double blind methods, etc., the goal was to establish the linear cause-and-effect relationships between independent and dependent variables — the efficient causes that could then be generalized by prediction and control to other like situations. In emulating earlier mechanistic physics, the results also had to meet the criterion of being "time independent." Thus, if the experimental hypothesis were tested at any other time — past, present, or future — the results would remain invariant.

While the use of randomized groups and other designs maximized objectivity, objective measurement was "aided" by the development of standardized normative tests. The effects of various interventions were then measured objectively using these instruments, i.e., intelligence, achievement, interest, etc.

The paradigm, which determines legitimate problems, developed a solution for objective measurement. The problem was converted into puzzle form for which there was a solution with defined rules.

Accepting the assumption of random distribution of a trait, e.g., intelligence, achievement, etc., and using Fisher's statistical Unit Normal Curve, the technology of standardized tests emerged. Clear rules for establishing reliability, validity and other psychometric procedures were developed. This resulted in objective measuring instruments which still dominate the educational field of evaluation. While these have proved to be very valuable for the purposes of a limited evaluation, e.g., measuring the effects of a given program intervention using appropriate control group designs, etc., they have not been able to measure growth of the individual or organizations over time. They remain essentially cross-sectional measures. This latter issue will be elaborated further in Chapter VI. It highlights one of the anomalies of the mechanistic paradigm, i.e., measuring change in the individual or group involving the emergence of novelty.

Anomalies. Those scientists who found a paradigm in Newton's Principia took the generality of its laws for granted. There were, however, early philosophical criticisms in the seventeenth century by Leibniz concerning Newton's conception of absolute space. However, it was not until the crisis in physics in the late nineteenth century that anomalies began to appear which led to relativity theory. Technical problems relating to the wave theory of light evoked a crisis in the 1890's. If light was wave motion traveling in a mechanical ether governed by Newton's Laws, then detection of drift through the ether was possible. Much equipment and experimentation were conducted but no drift was observable. The Michelson-Morley experiments later proved to be crucial in empirically resolving the problem but Einstein first solved it on theoretical grounds.

Newton essentially theorized that the laws of motion were the same everywhere. It was based on the concept that time was an imperturbable river flowing ever onward — an absolute. Matter and time, therefore, were treated as separate entities. Newton was able to use Euclidian geometry as the mathematical symbol system to conceptualize his laws of motion. With respect to matter in motion, Newton assumed that the natural state of matter was at rest and would move only if external force (efficient cause) were brought to play.

Einstein, basing his theory on the constant speed of light, viewed the problem of space, time, and matter in motion in a new way. He theorized that time and uniform motion are not constant but relative. An anology to show this relationship is two people traveling at different speeds in two space ships with clocks that can be seen from each. The faster the ships separate from each other, the more one of the clocks would seem to be slowed. Thus, if one ship could travel at the speed of light, each clock would appear to the observer on the other ship to have stopped. Not only was time relative but length proved relative also.

From his time-and-motion equations, Einstein derived the formula $E = mc^2$, which equates energy with mass times the speed of light squared. Briefly, matter gives off energy in the form of light, thus losing some mass, indicating that energy and mass can be converted from one to the other. This became empirically verified when uranium was split, converting part of its mass into great amounts of energy. It is notable that Newton viewed matter and energy as separate entities; Einstein essentially hyphenated them as matter-energy.

Einstein also showed that there was a continuity between space and time; these, too, were hyphenated into a space-time continuum. Thus, events for one observer which are separated by intervals of space and time are separated by different intervals of space and time for another observer.

In dealing with the anomalies of Newtonian mechanics, Einstein met the crisis in physics by moving into extraordinary science by inventing the general theory of relativity. He dealt with the problem of gravity which he believed was a force that could not be distinguished from any force we feel in accelerated motion. His concern was not with studying observers moving at constant speeds in straight lines but moving separately in arbitrary ways. For this he used mathematical equations from Reiman's geometry of tensor calculus. Euclid's geometry used by Newton could not handle the problem. In essence, he established that gravity was a distortion of space and time. The inertia of a planet will keep it moving in a straight line; however, a large mass — a sun — will influence the space-time continuum with the planet's path curving around the sun. A key concept from his general theory of relativity that could be empirically verified was that light (photons) would be bent by gravity because photons had mass. In 1919, astronomers photographed starlight passing through the gravitational field of the sun during a solar eclipse and it was bent to the degree that Einstein's theory predicted.

Dealing with the anomalies of Newtonian mechanics, Einstein invented the general theory of relativity which theoretically assimilated Newton's terrestrial and celestial laws as well as accounting for the current anomalies. This response of extraordinary science to the crisis in physics represents what Kuhn refers to as a scientific revolution — a major paradigm shift. Einstein's paradigm did not disprove Newton's Laws but made them a special case that still apply for matter traveling at ordinary speeds but not applicable at speeds approaching the speed of light. This paradigm shift gave us a totally new view of how nature works.

This illustration from physics parallels the process by which the anomalies of the mechanistic paradigm applied to the behavioral sciences can be theoretically assimilated by the organismic paradigm represented by the Anisa theories.

The following anomalies have been identified as leading to a theoretical crisis in the behavioral sciences based on the mechanistic paradigm.

Causation. From Galileo, Bacon and the acceptance of the Newtonian machine model of the universe, material and efficient causes carried the burden of explanation in the mechanistic paradigm. Material cause is the substance which constitutes the object; thus, for example, physiological, neurological, or genetic materials are necessary conditions for behavior. Efficient cause is the external force, the independent variable that moves the object. Formal and final causes were eliminated from mechanistic science. (Bunge, 1963; Rychlak, 1968)

Overton and Reese (1973) offer the following definitions: "Formal cause is the pattern, organization, or form of an object. Thus, the specifications of psychological structures, for example, constitutes a formal cause. Final cause is the end toward which an object develops. The attribution of an endpoint of development, such as differentiation and hierarchical integration, is an example of final cause." Formal and final causes are explicitly teleological.

An example from Piaget's theory can illustrate these causes which serve as the necessary and sufficient conditions to explain development. Genetic and maturational factors (material causes) interact with the physical and human environments (efficient causes) that effect structures (formal causes). Piaget holds that these are the necessary conditions for development. The introduction of equilibration (final cause), however, is needed to have a sufficient explanation of development. Piaget's theory, therefore, takes into account the four causes which provide the necessary and sufficient conditions for development. His theory is consistent with the organismic paradigm and compatible with the Anisa theory. Jordan not only introduces final cause but subjective aim which are the key theoretical concepts indicating the basis for a shift from the mechanistic to an organismic paradigm.

In addition to the four causal determinants, there are other problems concerning causality. For example, the mechanistic paradigm deals with efficient causes as external to the object. Based on the assumption that man is a reactive organism, he would then respond to external efficient causes. Causality would also be unidirectional or one-way with effect dependent upon cause. The concept of unidirectionality allows for the breakdown of stimulus-response relationships in the classical learning theory research designs.

If one takes the Anisa perspective, subjective aim and final cause are assumed and man is viewed as being proactive (i.e., the organism is inherently and spontaneously active), then external causation cannot in itself be the sole factor determining an effect. What results, therefore, are environmental events interacting with the organism in a relationship of reciprocal action wherein each effects and changes the other. Overton and Reese (1973) refer to this as "reciprocal causation" or interaction rejecting the mechanistic approach which maintains that a full efficient causality is possible. This will be elaborated further under the organismic paradigm.

The mechanistic paradigm also presupposes a linear cause-and-effect relationship that operates in chainlike sequences. There is an invariable one-to-one relationship implying that a particular cause will have a particular effect. Thus, it is possible to isolate the chainlike sequences and causes are additive in their effects.

An anomaly for the mechanistic paradigm is a non-linear relationship found in an organized complexity. This would be analogous to the process involved in the concept of negative entropy. The Anisa position does not rule out the concept of linearity but linear relationships cannot provide an adequate explanation for all of development. The problem, however, is to explain an organized complexity as an organized system with ordered changes in its development. What is needed is the discovery of the laws of organization.

The issue is characterized well by von Bertalanffy (1968):

> In the world view called mechanistic, which was born of classical physics of the nineteenth century, the aimless play of atoms, governed by the inexorable laws of causality, provided all phenomena...No room was left for any directiveness, order or telos...The only goal of science appeared to be analytical, i.e., the splitting up of reality into even smaller units and the isolation of causal trains...Organization...was alien to the mechanistic world...In biology, organisms are by definition organized things. Characteristic of organization, whether of a living organism or a society, are notions like those of wholeness, growth, differentiation, hierarchical order...etc. (p. 45).

The discovery and invention of the laws of organization, or teleological laws, are concerned with the formal and final causes of order in an organized complexity. They are primary — efficient causes are subsumed under them. Thus, in the Anisa theory of development, the concept of development subsumes learning and maturation.

Holism versus reductionism. The reductionist assumption of the mechanistic paradigm states that an organism is a collection of elements which cannot combine to yield emergent qualities (Overton and Reese, 1973). The Anisa position, based on the organismic view, holds that the organism is an organized totality with parts in interaction but obtaining their meaning from the whole. The interacting parts create emergent qualities that are a novel entity and are more than the sum of the parts.

Structure-function versus antecedent-consequent. The mechanistic view of man as reactive makes analogies based on antecedent-consequent relations. The organismic paradigm deals with functions or goals and the structures which achieve them. The analysis of structure-function involves the attribution of purpose to man. Purpose is inherent and conceptually it is explanatory (Overton and Reese, 1973).

The nature and direction of developmental change is a central concern for the Anisa theory of development. Consistent with the organismic view, structures and functions change during development with change directed by the purpose. The reactive view holds that it is behavior that changes and change is determined by efficient causes which are the result of external events, e.g., the reinforcement history.

Discontinuity versus continuity. The mechanistic view of reactive man holds that all change is continuous and is predictable from previous states — the reductionist position. Emergent qualitative differences in development are only apparent for they can be predicted. In contrast, for the organismic view as Overton and Reese observe, "... changes in the parts or the organization of the parts result in a whole with new or novel systemic properties. These new properties are emergent in the sense that they cannot be predicted from the parts. Thus, there is a basic discontinuity of development." Anisa theory not only deals with such changes in the ontological development of the individual but also in the emergence of new social structures and cultural forms.

Time: a measure of motion versus motion a measure of time. The mechanistic paradigm holds to the concept of motion being a measure of time — time being an absolute. Consistent with the assumption of the universe as a machine, once efficient cause-and-effect relationships are established they hold for past, present and future. One criterion of mechanistic science regarding experimental findings is that the results are "time independent." This problem is part of the crisis in social psychology (Gergen, 1973, 1976; Sherif, 1977; Gottlieb, 1977; Wolff, 1977; Secord, 1977). Social psychological experimental findings usually fail in replication for they do not fulfill the "time independent" criterion. When the subjects who participated in the experiment are no longer naive, (i.e. become aware of the experimental hypothesis) they fail to act as the hypothesis would predict. Thus, behavior varies unpredictably as a consequence of historical, cultural and social events as well as public knowledge about scientific explanation. Gergen (1973, 1976) challenges the fundamental premise upon which the mechanistic scientific enterprise is based: namely, that behavior is consistent and can be explained through cause-effect relationships.

One way the social psychology crisis could be resolved would be by giving up science and social psychologists becoming historians (Gottlieb, 1977). However, if it is to continue as a science, what kind of science would social psychology be? The Anisa organismic paradigm, this writer suggests, is a possible alternative. The Anisa science of education is relevant to social psychology in that the subject matter of both is people who interact with each other, with their environment, and social institutions. These organism-organism interactions lead to reciprocal change — one of the anomalies from the mechanistic point of view.

If time is an absolute as the mechanistic paradigm holds with motion or change a measure of time, then social psychology fails to achieve the "time independent" criterion of science. Thus, is social psychology or education a science or history? Using the Kuhnian perspective, however, we may view the failure of social psychology to achieve the expected paradigm outcomes, cited above, as a counterinstance and thus an anomaly. A theoretical crisis then exists. The crisis may be resolved by a theoretical assimilation of a new paradigm.

The first principle underlying the Anisa theories deals with universal constant of change or the translation of potentiality into actuality through a process that views the universe as hierarchically organized. Time inheres, therefore, in process which can be conceived as a measure of motion with the possibility of the emergence of novelty or new creation. Such a conception deals with the crisis in social psychology and gives us a totally new view of how nature works.

Karl Pribram (1979), a neuropsychologist, provides some empirical and theoretical evidence from his studies of holographic memory of significantly different views concerning space-time dimensions. Pribram believes the brain behaves, in part, like a holograph, which was invented by Gabor. Holography uses photographic film and laser light to create three-dimensional images that float in space. The viewer can move around them as if they were objects, seeing new angles as the viewer moves. The technical details are not pertinent here. What is germane, however, is the work done by David Bohm, a theoretical physicist who worked with Bohr, Heisenberg, Wigner and Einstein in quantum physics. Pribram cites that his work with the brain and Bohm's conceptions of the physical universe have in common an order of reality that is similar in organization to holograms.

Bohm points out that since the invention of the microscope and the telescope, man has been looking at the universe through lenses. Our conceptual models in physics and biology have been largely formed from such perceptions and thus limited. Since scientists try to be objective, a lense objective permits man to work with objects and particles. However, as Bohm observes in quantum physics, particles don't act only like objects but behave as if they were wave forms. These wave forms may compose hologram-like organizations or "implicate order." Pribram states: "That is a very different way of looking at the universe than the lens-defined world view and different from the "objective" approach, which Bohm refers to as the "explicate order." Since our senses (e.g. eyes, ears, etc.) are lens systems, the universe we see and understand is the explicate order which is the "real world" but not the only order of reality.

Pribram notes that Bohm worked with Einstein in his search for a unified field theory. Einstein believed that God did not play dice with the universe; he did not hold to the probablistic, statistical view that the physical universe is made of random movements of electrons, photons, quarks — particles. In searching for a unified field theory, Bohm deals with the conceptual solution to the particle-wave problem by proposing that behind haphazard appearance lies a domain of constraints. He felt that these constraints, when discovered, will have a consistent, nonstatistical basis for the appearance of random activity of individual particles.

Pribram states that if one looks at the universe with a "nonlens system" such as a holographic system, one has a very different reality which can explain phenomena previously inexplicable in science — paranormal phenomena and synchronicities.

Holographic theory, Pribram observes, as a way of looking at consciousness, is closer to Eastern philosophy which deals with an order of reality other than the world of appearances. There are many parallels in this view and Anisa theory, which is largely based on Whitehead's organismic position and represents a synthesis between Eastern and Western philosophies. This is developed further in Chapter IV. The particular concern, however, is the mechanism in the brain that can probe the "implicate order." The hologram and the Fourier-frequency domain deal with the density of occurrences only. Pribram notes that time and space are collapsed; boundaries of space and time (i.e., locations) disappear. In the absence of space-time coordinates, causality, which is the basis for mechanistic scientific explanations, is suspended.

Pribram uses the example of an EEG, where neither of the coordinates displays time or space indicating that it is possible to translate time-space phenomena into other domains. In the frequency domain, time and space collapse where everything happens all at once. These happenings, however, can be worked out on space-time coordinates, bringing us to the domain of objective appearance. Pribram uses the example of the brain which is holographically organized on dimensions other than space or time although space and time tags could be attached to memories.

Since there is now some empirical scientific base for understanding such phenomena, Pribram suggests that we discover the rules for "tuning in" on the holographic implicate domain. It could allow us to reach into the timeless and spaceless domain which corresponds to some metaphysical systems definition of God.

The parallels between Pribram's view and Anisa theory are considerable. An early philosophical concept of man as being proactive can be largely traced to Leibnitz. Pribram (1979) states:

> Leibnitz talked about 'monads', a windowless, indivisible entity that is the basic unit of the universe and a microcosm of it. God, said Leibnitz, was a monad. Leibnitz was the inventor of the calculus, the same mathematics that Gabor used to invent the hologram. I would change one word in the monadology. Instead of calling it windowless, I prefer to call monads lensless. In a monadic organization, the part contains the whole — as in a hologram. 'Man was made in the image of God.' Spiritual insights fit the descriptions of this domain. They're made perfectly plausible by the invention of the Hologram (p. 84).

The above highlights previous evidence concerning time that is an anomaly from the mechanistic view. The Anisa paradigm, it will be shown, is theoretically able to assimilate the mechanistic data and account for the anomalies.

Object-subject. The experimental methods used in the behavioral sciences, e.g., psychology and education, mirrored nineteenth century mechanistic physics in both method and assumptions. These were isomorphically transposed to the study of human behavior. The application of the experimental method as the paradigm for psychology and education had the effect of institutionalizing the method which preceeded the problem or content of study. Thus, the subject matter and the method of investigation were perceived in a similar fashion. Gadlin (1975) states:

> With the experiment seen only as method, the subject-experimenter relationship is prescribed as a person-thing relationship in which, as noted above, subjects are manipulable objects; that is, the experimenter-subject relationship is depersonalized because the 'objectivity' of the experimental method requires it (p. 1005).

Subject matter and method have been seen as separate and independent in early social psychology. Gadlin notes that subject "artifacts", i.e., evaluation apprehension where the subject experiences some anxiety to win a positive or at least not a negative evaluation from the experimenter, were recognized over fifty years ago. Nevertheless, while there was a conceptual crisis, the laboratory experiment continued as the accepted methodology; it continues with many defenders (Kruglanski, 1978). The dominant paradigm, therefore, is mechanistic based on a behavioristic version of the experimental method. Gadlin suggests an intensive exploration of alternative methodologies while acknowledging (as Kuhn) that it is scientific suicide to abandon the experimental method. Gadlin (1975) states: "We desire a movement toward a new paradigm. We consider the recognition of the existing paradigm a necessary first step toward that development in psychology."

Psychology should address phenomena as its first concern, not methodology. Gadlin would develop methods to fit phenomena rather than researching those that fit methods. Conducting research involves entering into relationships with people which do affect the outcome of the research. The current methodology requires an impersonal one wherein the subjects are treated as objects, but this is not really possible. This author believes Gadlin has clearly discovered an anomaly which requires an alternative paradigm.

Attempts to deal with this anomaly are explored by Gadlin with suggestions to consider the relational quality of research with what he calls "reflexivity." This perspective would treat subjects as informants; a method that allows teachers to learn from students as well as from their performance. Gadlin (1975) states:

> It also suggests some possibilities for a whole new range of research, in which those we formerly considered our subjects are now our collaborators, when its relational nature is acknowledged, can become a social project rather than a laboratory exercise...This self-consciousness includes the psychologist's awareness of his own role with respect to his inquiry...Understandably, we have only hinted at the possible content of an alternative paradigm for psychology (p. 1008).

It appears that Anisa offers such an alternative paradigm. The reflexive quality of the experimenter-subject relationship suggested by Gadlin, in essence, characterizes the teacher-student relationship prescribed in the Anisa theory of pedagogy; that methodology is the prototype for a science based on organism-organism interaction.

Because of the subjective aim and purpose of the individual, such a methodology is, therefore, necessary.

Means versus ends. Mechanistic science, in essence, is amoral or neutral, i.e., it states "what is"; it does not deal with the "what ought to be" questions. Axiological concerns of values, ethics, morals are not legitimate scientific questions within the mechanistic paradigm. The objective is to understand nature by being able to predict and control — essentially identifying efficient causes. As noted above, it recognizes only material and efficient causes as the necessary conditions for behavior and does not consider final causes which involve purpose as legitimate concerns of a science of behavior.

The anomaly can be demonstrated when Skinner's operant and respondent conditioning techniques are applied in the field of education. The systematic use of these techniques with children to create a better "reader" has been demonstrated with reasonable empirical success. It is, however, a very different order of question to use Skinner's theory to answer the question, "How do you create a 'good man'?" The mechanistic paradigm cannot answer such a question; in fact, considers it "meaningless" in a scientific sense. Skinner himself states that the learning theory techniques are neutral and can be used by a "saint" or a "sinner."

Kohlberg makes the observation that many studies of child development are conducted which statistically describe behavior characteristics of given ages. These descriptive studies are then frequently taken to mean that this is what "ought to be." Kohlberg refers to this as the "psychologist's fallacy." This "fallacy" has had an impact on educational practice; most educational theories of development are of this descriptive nature. These range from age-related descriptions of intelligence, achievement, weight, etc. which tend to become expected norms for teachers. Working within this mechanistic paradigm, it is not surprising that there are few "prescriptive" scientific theories of education — there is no basis for dealing with the "ought" issues.

The Anisa paradigm deals with efficient cause — acknowledges it as a necessary condition for understanding development. With the introduction of subjective aim and final cause, it also conceptually assimilates purpose — what ought to be. Both efficient and final causes are, therefore, the necessary and sufficient conditions for a prescriptive theory of education.

Theoretical crisis. The awareness of these anomalies and attempts to theoretically resolve them has created a crisis for the mechanistic paradigm as applied to the behavioral sciences. Kuhn (1970) states:

> Confronted with anomaly or with crisis, scientists take a different attitude toward existing paradigms, and the nature of their research changes accordingly. The proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and to debate over fundamentals, all these are symptoms of a transition from normal to extraordinary research (p. 91).

The transition from a paradigm in crisis to a new one is not a cumulative process or extension of the old paradigm. Kuhn characterizes it as a reconstruction of the field from new fundamentals that results in change in elementary theoretical generalizations as well as many of the former paradigm's methods and applications. The transition period from a mechanistic to organismic paradigm will involve enormous problems that can be solved; but, when the transition is complete, the profession will have a changed view of its methods and goals. It is analogous to a change in visual gestalt where lines that were first seen as a bird are now seen as an antelope, or vice versa. The switch of gestalt is a prototype of what happens in a paradigm shift. When the paradigm changes, the world itself changes; scientists create new instruments and look in new places but also see different things in aspects of the world they looked at before. In this revolution from the normal scientific tradition, there is a reorganization where the scientist learns to see a new gestalt. When the switch is complete, the scientist's world of research will appear incommensurable with his previous one. Scientists operating under different paradigms are always at some degree of cross-purpose.

It is notable that major paradigm changes like Copernicus or Einstein, as well as smaller ones, like oxygen or X-rays, may appear revolutionary only to those whose paradigms are affected by them. To those not involved they may seem a normal process of development. Chemists could accept X-rays as an addition to knowledge because their paradigms were not affected by the new radiation. For Kelvin, Crookes, and Roentgen, however, X-rays violated their existing paradigm. This parallel will be helpful in understanding the reaction of a paradigm shift in the educational community. Since education is generally at a pre-paradigm stage, only those educational researchers practicing under the mechanistic paradigm will be primarily affected. Most will probably view the changed concepts as another educational theory.

It is notable that educational scientists, representing a family of theories dealing with a field of knowledge, can be grouped even though their content areas differ. For example, Piaget, Werner, Jordan, et al. represent theories formulated within what will be developed as the organismic paradigm; Skinner, Hull, Miller, et al. represent theories within the context of the mechanistic paradigm. Those practitioners working within one or the other of these theoretical families will be affected. Theoretical controversies from different theoretical families represent within paradigm debates; differences within the same family focus on theoretical and empirical issues, not epistemological or paradigm concerns.

Differences between paradigms, however, are irreconcilable. Therefore, attempts at a synthesis or eclectic approach between Jordan and Skinnerian behaviorism are futile. These represent different world views and have different criteria for establishing truth of propositions.

Kuhn (1970) states the difficulty of communication that exists when different paradigms are involved:

> To the extent, as significant as it is incomplete, that two scientific schools disagree about what is a problem and what a solution, they will inevitably talk through each other when debating the relative merits of their respective paradigms. In the partially circular arguments that regularly result, each paradigm will be shown to satisfy more or less the criteria that it dictates for itself and fall short of a few of those dictated by its opponent. There are other reasons, too, for the incompleteness of logical contact that consistently characterizes paradigm debates. For example,

> since no paradigm ever solves all the problems it defines and since no two paradigms leave all the same problems unsolved, paradigm debates always involve the question: Which problems is it more significant to have solved? Like the issue of competing standards, that question of values can be answered only in terms of criteria that lie outside of normal science altogether, and it is that recourse to external criteria that most obviously makes paradigm revolutionary (pp. 108-109)...Since new paradigms are born from old ones, they ordinarily incorporate much of the vocabulary and apparatus, both conceptual and manipulative, that the traditional paradigm had previously employed. But they seldom employ those borrowed elements in the same way (p. 148)...most fundamental...the proponents of competing paradigms practice their trades in different worlds...Both are looking at the world and what they look at has not changed. But in some areas they see different things, and they see them in different relations one to another. That is why a law that cannot even be demonstrated to one group of scientists may occasionally seem intuitively obvious to another (p. 149).

Kuhn further elaborates on the meaning of a paradigm which is what the members of a scientific community share. Thus, a paradigm governs not a subject matter but a group of practitioners. Understanding paradigm-directed or paradigm-shattering research begins by knowing the responsible group or groups.

Daniel Jordan et al. took man as the primary unit of study, reviewed the historical thinking on his nature, and was largely influenced by Whitehead. Whitehead's process metaphysics, which serves as the basis for an organismic view of nature, is the fountainhead of a group leading to a new scientific community. For the past eighteen years, Jordan and his colleagues have been laboring to formulate a set of first principles from which could be deductively derived a coherent body of theory dealing with all aspects of education. The conceptual base rests primarily on the work of process philosophers and is organismic in nature.

The Anisa Paradigm

Presuppositions. Scientific research begins only after a group believes it has answers to basic questions: What are the fundamental entities of which the universe is composed? What questions may legitimately be asked about such entities and what techniques employed in seeking solutions?

The basic presupposition of Anisa is its first principle — the bedrock statement of the nature of reality (Jordan, 1972). Change is the universal constant. The becoming state is contained in the beginning state; therefore, change presupposes potentiality. The legitimate question to be asked about such an entity as potentiality is how it is released into actuality. Process is how potentiality is transposed into actuality; thus Anisa theories focus on process, and related research seeks solutions to puzzles concerning the nature of process.

The basic metaphor of the organismic paradigm is the living organism, an organized whole. In contrast to the machine, the whole is organic, equal to more than the sum of its parts, and gives meaning to the interrelated parts. The whole is in continuous transition from one state to another through differentiation and integration. The progressive change is not the result of only efficient cause-and-effect but involves subjective aim and final cause — teleological relationships. Change is both qualitative and quantitative in which the parts and configuration of parts change. Thus new organizations emerge irreducible to lower levels and qualitatively different from them. It precludes the mechanistic view of a completely predictive and quantifiable universe.

In other terms, it represents the active organism model of man. Because of subjective aim and final cause, man is inherently and spontaneously active rather than activated by external efficient causes only. He is an organized complexity that tends toward higher levels of organization and integration. Change is given; it is not explainable by efficient or material causes alone. Although efficient causes are necessary and may inhibit or facilitate change, final causes are basic with both required for the necessary and sufficient conditions to understand change — development.

This shift in metaphors from the machine to purposive organism gives us a new world view — the basis for a paradigm shift. The introduction of subjective aim and final cause theoretically assimilates the anomalies discovered in the mechanistic paradigm. It does not negate efficient causation but makes it a special case quite analogous to the scientific revolution from Newtonion to Einsteinion physics.

For the behavioral sciences, particularly psychology and education, the basic Anisa presupposition offers the basis for a new paradigm. The Anisa theories, as a disciplinary matrix, move education out of its philosophical and pre-paradigm stage of competing theoretical schools. Its great power and scope move it to a paradigm status for education and the beginnings of a dual paradigm status for the behavioral sciences. It makes conceptual order out of a variety of competing theoretical models and is the necessary first step en route to normal science. As noted above, theoretical schools, e.g., Piaget, Werner, cybernetics, information, communication theories, etc. fall primarily under the organismic paradigm. As a paradigm shift it is able to incorporate the mechanistic paradigm as essentially a special case. Thus, there is a large cohort — community of scientists — who are already committed and working within the organismic paradigm.

Having isolated a community of specialists, the question is raised regarding what they share that accounts for the professional communication and relative agreement of their professional judgments. While the answer is a shared paradigm, Kuhn further observes that scientists share a theory or set of theories. Kuhn introduces the term "disciplinary matrix" because "...it refers to the common possession of the practitioners of a particular discipline; 'matrix' because it is composed of ordered elements of various sorts, each requiring further specification." Some elements Kuhn refers to as "symbolic generalizations" which are expressions accepted without question which permits the group to use powerful techniques of logical and mathematical manipulation in their puzzle-solving activities. For example, "elements combine in constant proportion by weight", or "action equals reaction", or Joule-Lenz Law, $H=RI^2$ which allowed the community members additional understanding of the behavior of heat, current, and resistance.

In addition, Kuhn states that members of a shared paradigm hold commitments to beliefs in particular models (e.g., the electric circuit may be regarded as a steady-state hydrodynamic system; the molecules of a gas behave like tiny elastic billiard balls in random motion). The models provide the group with permissible analogies and metaphors which help to determine acceptable puzzle-solutions as well as identifying unsolved puzzles.

Another component of a disciplinary matrix concerns values shared by a scientific community particularly when dealing with a crisis or choosing between different ways of practicing their discipline. Examples of deeply held values concern predictions which should be accurate, quantitative, and specify margin of error. Another example is the setting of values for judging whole theories: puzzle-formulation and solution, simple, self-consistent, etc. Other values concern the social usefulness of the science itself.

These components should prove helpful in communicating and understanding among a variety of disciplinary matrices working within a single paradigm. Differences, again, that exist within theoretical families are not incommensurable as are differences between paradigms.

Grand discovery. A paradigm is more than a scientific group's shared commitments; paradigms are based on shared example — the "exemplar." For Newton's paradigm, his f = m x a served as the primary exemplar; "Skinner's box" provided the example of the mechanistic paradigm applied to the behavioral sciences.

The primary exemplar for the Anisa paradigm is learning, which is defined as "...the conscious ability to differentiate aspects of experience, integrate them into novel patterns, and generalize them to other situations. Differentiation, integration, and generalization constitute a trio of interrelated processes that defines a developmental unit of change — a state. Sequences of stages are the primary means by which increasing complexity of function and structure is built up and integrated through hierarchical organization" (Jordan, 1974).

The role of the exemplar for a paradigm is its scientific achievement which serves as the basis for practice. The common belief that scientific knowledge is embedded in theory and rules learned in laboratories or texts is wrong. Kuhn (1970) states:

> After the student has done many problems he may gain only added facility by solving more. But at the start and for some time after, doing problems is learning consequential things about nature. In the absence of such exemplars, the laws and theories he has previously learned would have little empirical content (p. 188)...learning is not acquired by exclusively verbal means. Rather it comes as one is given words together with concrete examples of how they function in use; nature and words are learned together. To borrow once more Michael Polanyi's useful phrase, what results from this process is 'tacit knowledge' which is learned by doing science rather than by acquiring rules for doing it (p. 191).

The implications of "learning" as the exemplar for the Anisa paradigm are yet to be understood and appreciated. Anisa science (exemplar of learning) is learned by doing rather than by acquiring rules for doing it. The teacher is actively involved in becoming a competent learner as he reciprocally interacts with the learning of his students. The generative aspect of the Anisa teacher is salient. The relationship of teacher to student is not the classical experimenter-subject but analogous to Gadlin's suggested reflexive model where the student is treated as both object and subject.

The implications of learning as the exemplar for practicing this science are clear concerning the controversy between applied and basic research in instruction (Bruner, 1964; Glaser, 1976; Snow, 1977; Kerlinger, 1977). Kerlinger makes the distinction between basic and applied research: "Scientific research never has the purpose of solving human or social problems, making decisions and taking action. The basic researcher is preoccupied with, and should be preoccupied with, variables and their relationships." He holds that the purpose of applied research "...is to help in making decisions...to relatively specific problems..., but this problem solving does not ordinarily lead to understanding of the complex phenomena behind educational practice." The "basic research" approach is within the normal puzzle-solving of mechanistic science. This approach is not precluded for certain kinds of problems with our multivariate statistical methods, sophisticated research designs, and computer data processing means in natural classroom settings.

Learning as the Anisa exemplar, however, largely eliminates the distinction between basic and applied research. Bruner (1964) and Glaser (1976) see the present change in theory-building from describing to prescribing. The Anisa approach fulfills Glaser's arguing for a "science of design." Glaser states: "...a theory of learning is descriptive, whereas a theory of instruction is prescriptive in the sense that it sets forth rules specifying the most effective way to achieve knowledge or mastery of skills."

He further identifies elements of a prescriptive theory:

> Regardless of the descriptive theory with which one works, four components of a prescriptive theory for design of instructional environments appear to be essential: (a) analysis of the competence, the state of knowledge and the

> skill to be achieved; (b) description of the initial state with which learning begins; (c) conditions that can be implemented to bring about change from the initial state of the learner to the state described as competence; and (d) assessment procedures for determining the immediate and long-range outcomes of the conditions that are put into effect to implement change from the initial state of competence to further development: (Glaser, 1976, p. 8).

Glaser holds, therefore, that instructional theory be embedded between theories of learning and actual school practice. The Anisa theory is basically prescriptive and consistent with Bruner and Glaser, and it resolves some of the above issues currently being debated.

Beyond the current debates — generally within the mechanistic paradigm — the significance of learning as the primary exemplar for establishing Anisa as a paradigm can best be shown by placing its role in an evolutionary perspective. Anisa, as a cosmology, is consistent with the "big bang theory" in physics; it is also consistent with general systems theory supporting the concept of a continuous and highly differentiated evolutionary process. The basic concern is the evolution of organized complexities. Empirical sciences have developed laws, as noted above, for the evolution of matter, biology, eco-systems, socioculture, and principles for the evolution of science itself, e.g., Piaget and Kuhn. Anisa, as a process metaphysics, therefore, encompasses both the micro- and macro-levels — the reductionist as well as a general theory of organization including social change.

Daniel Jordan, in reviewing the empirical evidence of evolution, notes that there appear to be "leaps" in this process. One such leap, for example, in the evolution of man was man's release from efficient cause (instinct); this release resulted in increased freedom and consequent responsibility — the basis for ethics and morality. The key to the increased role of subjective aim and final cause in the process was learning. It remains the exemplar for man as he consciously takes charge of his own ontological and phylogentic development by becoming a competent learner — learns-to-learn. Thus, Jordan's concepts of differentiation and integration are operative at the biological levels with generalization added at the psychological. It appears intrinsically appropriate that "learning" should be the exemplar for a paradigm of education.

Method. The basic metaphor of the Anisa paradigm is the living organism — an organized whole. Since the whole is organismic rather than mechanical, the whole is equal to more than the sum of the parts and gives meaning to the parts. Primarily through differentiation and integration (i.e., learning) the whole is in progressive change from one state to another. While the changes may involve efficient cause-and-effect connections, in order to explicate the process the subjective aim and final cause relationships must be included. In essence, this represents the paradigm shift for it assimilates both the necessary (efficient cause) and the sufficient (final cause) conditions as basic to understanding the process of change.

Man, the active organism at the apex of evolutionary development, is inherently active; change is the constant and given. While efficient causes can enhance and suppress change, subjective aim and final causes are primary. Change is also both quantitative and qualitative where the configuration of parts change, resulting in the emergence of newly organized complexities.

The complete causal mechanistic determinism ideal of objectivity, prediction, and control symbolized in quantitative terms is rejected. An organized complexity, however, consistent with negative entropy, allows for an open system that permits the emergence of originals — a theory of improbability with the ultimate prediction of one change in infinity.

Since Anisa represents a paradigm shift that makes the mechanistic research designs special cases within the organismic framework, what are, then, the appropriate research methods? The answer to this key question will largely determine the viability of the organismic paradigm. Again, the organismic paradigm subsumes the mechanistic as a limited case; thus, the organismic extends rather than contradicts the mechanistic methods. For example, the locus of behavioral change is viewed as external from the mechanistic perspective; but both internal and external from an organismic perspective. Merlina (1975) suggests that both perspectives may overlap: "There might be a certain range of phenomena when the two make such identical pronouncements that the simpler of the two can be used without hesitation." For example, Kohlberg's theory of cognitive development hypothesizes mechanistic processes to account for early acquisition of reading while organismic processes account for later development of formal logical operations (Howard, 1979). Other evidence suggests that mechanistic principles may parsimoniously explain certain habitual behaviors but organismic principles may best account for the emergence of adaptive behaviors. Thus, human survival is enhanced by both processes which help maintain a balance between stability and change.

It is helpful to understand this overlapping for the Anisa theories of development, curriculum, administration, and evaluation have been inductively based on many empirical studies conducted within the mechanistic perspective. The focus of this study, however, is concerned with the issues of evaluating a research paradigm in its own right and in relation to the Anisa paradigm that gave rise to it. Therefore, the methodology of the classic experimental tradition is acknowledged as a limited case. If the new paradigm is to prove viable, the invention of new research methodologies must assimilate the discovery of the anomalies under the old.

A great deal of creative effort will be required as the paradigm emerges into its "normal science" stage. Much work has already been done by creative scientists laboring within a family of theories that can be grouped under the organismic paradigm, e.g., Piaget, Werner, Bertalanffy, Laszlo, et al. Anisa, as a paradigm for education, draws heavily on these accomplishments but is not limited by them for the paradigm itself will generate new methodologies.

Since the process of inventing new research methodologies based on the Anisa paradigm will need to deal with the anomalies discovered under the old — but not restricted to them — each of the identified anomalies will be treated separately. While they are highly interrelated and difficult to organize into a hierarchy, the key issues are concerned with reciprocal causation and organized complexities. The overlapping issues of means-ends and object-subject will also be addressed.

Causality. First, the new methodologies must deal not only with the anomalies related to the unidirectional, linear, cause-and-effect relationship of efficient causation, but also with final causes. Toward this end, research designs will involve concerns for reciprocal causation in explaining development. Thus, the organism and the environment stand in a relationship of reciprocal action in which each member affects and changes the other. This reciprocal causation — interaction — rejects the mechanistic method which holds that a total efficient causality is possible.

Reciprocal causation is concerned with research strategies that deal with interactions that are either weak or strong. Overton and Reese (1973) characterized weak interactions as those that might be involved in most short-term learning studies that can be handled by the traditional experimental design of independent variable (efficient cause) operating on the dependent variable and analyzed using the usual statistical procedures. Where the interactions are strong, as in development over a long period of time, the traditional procedures break down. Different questions are raised about strong reciprocal causality which also involve explanations concerned with final causation. Thus, if Anisa represents a paradigm shift, it must be able to deal with efficient causation.

Kuhn's concept that each paradigm determines the legitimate puzzles and rules for their solution is illustrated by the way Piaget deals with the problem of reciprocal causality or interaction in the research process as contrasted with traditional learning theory. Piaget deals with reciprocal causation using concepts of assimilation and accommodation — the former is concerned with the influence of the organism on the environment; the latter with the influence of the environment on the organism. Learning theory, in contrast, specifies the identification of stimulus and response as independent factors. The contrast of these two approaches will illustrate the differences in research strategies generated by the respective paradigms.

Under the mechanistic paradigm the legitimate problem and concomitant research strategy for understanding the factors involved in ontogenetic development is defined as the nature-nurture problem. Thus, the legitimate questions are "Which one?" and "How much?" in order to understand the contributions of nature (heredity) and nurture (environment) to individual development. These are legitimate and meaningful questions involving unidirectionality of efficient causation in research strategies attempting to partial out the hereditary and environmental factors.

From the Anisa (organismic) perspective, however, the questions of "Which one?" and "How much?" are by themselves meaningless questions. The legitimate question is "How?" This can best be illustrated by the organismic view held by Piaget. Since development involves reciprocal causation, there are strong interactions between material and efficient (environment) causes. More specifically, heredity structures interact with the environment and give it meaning (assimilation) and concomitantly these structures change (accommodation) to environmental demands (efficient causes). There is, therefore, strong interaction between heredity and environment — an epigenetic view. Thus, research strategies that attempt to partial out the factors are meaningless (Reese and Overton, 1973).

The legitimate question for Anisa is "How?" Since the Anisa theory of development cannot be explained fully by material and efficient causes only, the necessary and sufficient conditions require final causes to understand the course of development. The legitimate research question, therefore, is "How?" efficient causal factors and how material factors relate to the final level of development.

This illustration demonstrates the key role that a paradigm plays in determining legitimate research problems. Having identified the puzzle, however, is only the first step in working out the rules for its solution. It is again desirable to note the futility in evaluating research done within one research paradigm in terms of rules that stem from another research paradigm. Since Piaget's theories are consistent with the organismic position, their related research methodologies offer an established framework for the emerging Anisa paradigm.

As Jerome Bruner (1976) observes, the Genevan research requires a "clinical method." Thus, if one were exploring the underlying structure of a particular performance, it would be necessary to deviate from the strictly controlled procedures to probe for the child's reasons and draw out his reactions to procedures. This "clinical method" has never lent itself to the strictly controlled designs that the dominant mechanistic paradigm demands in American learning experiments. But, as Bruner (1976) states:

> ...we would surely be lacking in historical insight if we failed to recognize that the work of the Geneva school, for all its "untidy" naturalism, has provided a generation of American developmental psychologists with a set of robust phenomena on which they could exercise their astringent rigor with great profit (p. 226).

Bruner notes also that there was a long period of disdainful neglect of Piaget's work primarily on methodological grounds. This issue is related to what could be referred to as paradigm-mixing. Anisa, as a paradigm shift, however, gives conceptual order to this earlier methodological confusion.

The research strategies developed by the Genevan group involving the "clinical method" are consistent with Anisa; they can serve as prototypical designs for future Anisa studies. Other approaches that attempt to explicate the ways in which the developing organism interacts with its environment are the ecologically oriented strategies that are compatible with the Anisa paradigm (e.g., Bronfenbrenner, 1978; Willems, 1973; Wohlwill, 1966; Lorenz, 1977).

To be more specific with the issue of reciprocal causation, a research method suggested by Bandura (1978), a social learning theorist, will be presented as an illustration for future studies. The analysis of behavior in terms of reciprocal determinism involves understanding the production of effects by events but not in the doctrinal sense that actions are completely determined by a prior sequence of causes independent of the individual. Events are probabilistic rather than inevitable because of the complexity of interactions. People are not simply reactors to external stimulation and cognitive factors partly influence which external events will be observed, perceived, organized, etc. Through symbolization and reflective thought, plans of foresightful action are created. Thus, by altering the environment, creating self-inducements, and conditional incentives, people have some influence over their own behaviors. Bandura, in agreement with Piaget and Jordan, holds that an act includes among its determinants self-produced influences (subjective aim). From a social learning perspective, psychological functioning involves a continuous reciprocal interaction between behavioral, cognitive, and environmental influences.

Historically, social psychology held that locus of the causes of behavior were individual dispositional and situational determinants. There was general agreement that behavior results from the interaction of persons and situations. However, the interaction view and related methodology held to a unidirectional orientation. These can be summarized in the following schematic (Bandura, 1978):

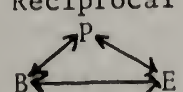
Unidirectional

$$B = f\ (P,E)$$

Partically Bidirectional

$$B = f\ (P \rightleftarrows E)$$

Reciprocal



B signifies behavior, P the cognitive and other internal events of the person, and E the external environment.

In the unidirectional concept of interaction, persons and environments are treated as independent variables that combine to produce behavior. The methodological concerns are analogous to the nature-nurture issues and the kinds of research designs used to study them.

The bidirectional concept recognizes that both personal and environmental influences are operative; nevertheless, it holds a unidirectional, cause-and-effect view of behavior. Persons and situations are held to be interdependent causes of behavior, which is a byproduct that is not involved in the causal process. The research methodology used relies heavily on factorial designs in which responses of individuals are measured under differing situational conditions. Analysis is then made to determine how much of the variation is due to personal characteristics, how much to situational factors, and how much to their joint effects. The basic weakness in this conceptual scheme is treating behavior as a dependent rather than an interdependent factor.

In the interaction of reciprocal determinism, however, behavior, internal personal factors, and environmental influences all operate as interlocking determinants of each other — a process of triadic reciprocal interaction. The relative influence of these interlocking factors will vary; thus, in some cases environment will emerge as the dominant factor. For example, if a person were dropped in deep water, he would engage in swimming irrespective of his varied cognitive and behavioral repertoires. In other instances, cognitive factors are the primary influence as in defensive behavior based upon false beliefs which keep the individual out of contact with environmental conditions that might serve as a corrective influence resulting in extreme cases of bizarre internal contingencies that neither the beliefs nor actions are affected by extremely punishing environments.

The methodology for evaluation of these processes requires analysis of sequential interactions between the triadic, interdependent factors within the interlocking process. Few investigations have been conducted that have examined more than two interacting factors simultaneously. From Bandura's perspective of reciprocal determinism, the search for the environmental cause of behavior is a futile effort because, in an interactional process, one and the same event can be a stimulus, a response, or an environmental reinforcer depending on where in the sequence the analysis begins.

Differences between unidirectional and reciprocal analyses of behavior are sharply drawn regarding self-regulatory phenomena. Radical behaviorism disavows any contract of "self." In contrast, internal determinants conceptualized as self-concept (Rogers, 1959; Sullivan, 1953) have gained increasing attention among reciprocal researchers.

Social learning theory (Bandura, 1978), however, treats reciprocal determinism as central in analyzing phenomena at different complexities from intrapersonal, interpersonal to interactive functioning of organizational and societal systems. An individual's concepts influence what he perceives and does, and, in turn, his concepts are altered by the effects of his actions and consequences to others. A notable difference between information-processing models, which are primarily concerned with internal mental operations, is the process of understanding how conceptions are converted to actions. Thus, people play an active role in creating information-generating experiences as well as in processing and transforming stimuli impinging upon them. The computer metaphor does not handle the reciprocal transactions between thought, behavior, and environmental events. An individual is not only a perceiver, knower, and actor but a self-reactor capable of reflective self-awareness.

The concept of freedom has meaning. In their conceptions, behavior, and environments or reciprocal determinants, individuals are neither powerless robots controlled by efficient environmental forces nor entirely free to do whatever they choose. Thus, man can be considered partially free as he shapes his future conditions by influencing their causes of action and creating structural mechanisms for reciprocal influence, e.g., organizational systems of checks and balances, legal systems, etc. Institutional reciprocal mechanisms provide a process of social change for safeguards and against unilateral control. The process of reciprocal determinism offers the opportunity for man to shape his own destiny as well and the limits of his self-direction.

The research methodologies that are appropriate for dealing with reciprocal causation clearly demonstrate paradigm differences. The structure-function versus the linear, antecedent-consequent unidirectional causality are key issues in the mechanistic and organismic views. Differences that exist among Bandura, Piaget, Chomsky (1968), and Jordan are within-theory differences and not paradigm differences. Thus, for example, the Anisa assumption of subjective aim as a given in the active organism parallels Bandura's self-regulatory functions. There are also parallels between Chomsky's "nativist" notion that all intellect is present at birth and Piaget's notion that cognitive structures develop through interaction involving assimilation and accommodation. These within-theory differences can be reconciled on empirical and theoretical grounds.

Jordan's concept of subjective aim and Chomsky's "wired in" human language have wide areas of convergence. Jordan, however, introduces final cause in addition to Chomsky's material, formal, and efficient causation to explain development. Chomsky's perspective is much narrower, though within the organismic perspective. The substantive and methodological problems involved are potentially reconcilable, whereas the Jordan-Chomsky-Piaget and Skinner-Hull et al. are incommensurable, the latter basing their methodologies on linear, efficient causation.

Organized complexities. The second methodological issue still related to causality is concerned with organized complexity. The Anisa paradigm deals with the problem of change; this holistic position maintains that changes in the organization of the parts result in a whole with new or novel systemic properties. These new emergent structures cannot be predicted from the parts. From the Anisa perspective, the explanation of the new organizational properties are not found in the antecedent, efficient causation but in the discovery of laws of organization involving formal and final causes. These teleological laws subsume efficient and material causal laws. The research strategies for the latter generally involve the linear aspects of analysis of variance statistical models. These models are essentially mechanistic attempting to isolate linear causal chains. They cannot deal with interaction — reciprocal causation — that introduces novelty or an organized complexity where the whole has characteristics that are not present in the separate parts.

Since the whole is equal to more than the sum of the parts, the key research issue is the discovery and invention of methods that can help us understand the "more" in the sum of the parts. We are concerned with the process of organic growth — both ontological and phylogenetic. Major issues are involved when we attempt to explain the nature of an organic creative process where something entirely new comes into existence — something that was not there before. This is demonstrable at the physical level where two independent electrical systems are coupled together and a new entirely unexpected system characteristic will emerge. Cybernetics and general systems theory have demonstrated the sudden emergence of new systems characteristics explainable, however, by a linear causal chain joining to form a cycle which produces a system with properties that differ from all preceding systems.

Many scientists have acknowledged that progress in organic development is usually achieved through the integration of different and independent systems to form a unit of a higher order. Bertalanffy (1968) describes this process in General Systems Theory. Teilhard de Chardin (1956) summarizes by stating, "To create is to unify." This process has been operative from the beginning of life.

Lorenz holds that no system on a high level of integration can be deduced from a lower system. He further states:

> We know with certainty that higher systems have arisen from lower ones, absorbing them and containing them like bricks in a building. We also know...the earlier stages in development from which higher living beings emerged. But each step forward has consisted of a fulguratio ("flash of lightning"), a historically unique event in phylogeny which has always had a chance quality about it — the quality one might say, of something invented (p. 35).

The emergence of novelty allows for one change in infinity. Jordan holds that the key to this process (creating novelty) is learning over which man has some conscious choice. The methodological issue, however, is how we can analyze such highly developing systems.

Lorenz (1973) states that in the analysis of highly developed systems the laws and characteristics of any system, like those of the individual subsidiary systems within it, have to be explained on the basis of the laws and characteristics of the system on the next lower level of integration. This becomes possible only when one knows the structure of the higher entity formed by the evolution of the systems on this level. He further states, "If one assumes complete knowledge of this structure, it is theoretically possible to explain every living system and all its functions, even the most advanced, in natural terms without adducing supernatural factors." This is possible, however, only if we accept the present structures in the creature's body as our data — if we are not interested in its historical evolution.

The answer as to why a particular organism is structured in one way rather than another is to be found, according to Lorenz, in the history of the species. Thus, to the question why our ears are on the side of our heads, the causal answer is that we are descended from water-breathing ancestors who had gill slits at these points. Therefore, to know the purely historical causes to fully explain why an organism is as it is approaches infinity. Lorenz gives the example that evolution produced oak trees and human beings in the Old World, but eucalyptus trees and kangaroos in Australia is the result of presently undetectable causal sequences which we now describe as "chance." Lorenz's view, however, is within the efficient causation of the mechanistic perspective. He characterizes Western thought of look through the "rear view mirror."

Michael Polanyi (1958) postulates that a higher animal cannot be understood by examination of its simpler ancestors nor can a living system be reduced to inorganic matter and the processes that take place within it.

Anisa looks through the "windshield" with its concern for man and his creative advance into the future. Since man is to some degree freed from efficient causation (instinct), he can through the process of learning create — direct his own ontological and phylogenetic destiny. He is consciously capable of structuring the unknown by projecting an ideal which then directs his energies — a process requiring the emergence of novelty. The concepts of subjective aim and final cause are introduced to deal with purpose.

While change is the constant, there is a dynamic balance between stability and novelty. This is reflected in the concepts of immanence and transcendence which translates operationally into administration as the balance between leadership and management. In this process, new organizational structures emerge. Some of these new organized wholes emerge with a high degree of stability — adaptability not predictable from knowledge of the component parts. One of the methodological research issues is understanding the "whole" being which is "more" than the sum of the parts. At the physical level, Buchminster Fuller illustrates this with his concept of synergy which is operative in the added strength that results in the nickel-chromium-iron alloy discussed earlier (p. 42).

At the physical levels, also, the cybernetics breakthrough which has led to the "second industrial revolution" demonstrates the application of this approach by the sophisticated technological hardware already developed. Based on the assumption of negative entropy (a closed system with degradation of energy), there is an open system where energy is available to accomplish a purpose — an organized complexity. Information and communications theories relying on circular, causal and feedback mechanisms have produced significant hardware, e.g., computers, communication systems, etc.

At the biological level, Bertalanffy's General Systems Theory illustrates the extension of organismic thinking which has spearheaded major new research methods. General Systems Theory applied to the psychological and social levels has given rise to ecological research methods. Bronfenbrenner (1977) delineates an approach to research in human development that focuses on progressive accommodation throughout life between the maturing individual and his changing environments. These environments include the immediate and larger social settings. With respect to method, his approach uses rigorously designed experiments, both naturalistic and contrived. The changing relation between persons, behavior and environments is conceptualized in general systems terms. He develops a series of propositions with illustrated research examples that are largely consistent and can serve as prototypes for Anisa research. These approaches represent a family of theories with research methods appropriate to various hierarchical levels that are convergent with the Anisa paradigm as applied to an educational setting. Chapter VII will explore in greater detail the paradigm implications for an Anisa theory of evaluation.

Object-subject. Although the issues of reciprocal causation and organized complexity are integrally related to the object-subject anomaly, the methodological research concerns will be discussed separately. The rigor demanded by mechanistic science calls for the "hard methodologies" which involve the experimental method. As Gadlin (1975) observes,

> ...psychologists have seen both the subject matter and method of investigating that subject matter, the experiment, in the same light. (p. 1005)...With the experiment seen only as method, the subject-experimenter relationship is prescribed as a person-thing relationship in which...subjects are manipulable objects; that is, the experimenter-subject relationship

> is depersonalized because the 'objectivity' of the experimental method requires it (p. 1005).

Abandoning the experiment would be desertion of a paradigm — a form of scientific suicide. Gadlin suggests an alternative methodology that can lead to the "real" scientific paradigm for psychology. In essence, he believes that consideration of phenomena should precede consideration of method. Rather than selecting for research phenomena suited to our methods, we should develop methods to fit phenomena that are of concern to us.

In mechanistic science, problems are decomposed into independent and dependent variables to fit an appropriate experimental design. The goal is to isolate the efficient cause-and-effect relationships. This is accomplished by control of variables which can be measured by objective means. The ideal is to be objective by eliminating any experimenter participation — the double blind design epitomizes the degree of objectivity used to isolate the efficient causes. B. F. Skinner's approach also treats the "subject" as an "object" who reacts to external efficient causes. The systematic application of his research method (an applied behavior analysis par excellence) is also the basic treatment and basic research method — contingency management. The close coordination of the treatment method to the research process gives applied behavior analysis an enviable degree of objectivity, rigor, and precision.

The limitation to this rigor and objectivity, however, is to reduce the subject (student) to an impersonal object who is merely reactive to environmental positive and negative reinforcement schedules with an external locus of control. In contrast, the active organism, given subjective aim and final cause, maintains an internal locus of control involving reciprocal causation. Thus, the Anisa theory of teaching acknowledges the subject's volitional potentiality and prescribes the arranging of environments by the teacher to guide the quality of interaction so as to release the student's potentialities at an optimum rate. The teacher, therefore, must take into account the subjective aim of the student in guiding the quality of interaction; thus, the student becomes both object and subject. The Anisa theory of teaching, therefore, becomes not only a prescriptive method of teaching, but a new organismic research method.

It is fully consistent with the alternative research methodology suggested by Gadlin. As Koch also pointed out, many current problems in psychology and education are a consequence of "method preceding content." Anisa acknowledges the primacy of the phenomena it studies — release of human potential through learning — and provides an appropriate research methodology. As Gadlin suggests, research should be reflexive which means entering into relationships that are not impersonal ones; relationships where the experimenter (teacher) learns from her students about their performance as well as from their performance. It opens possibilities for a range of new research where students who were formerly considered subjects became collaborators in research endeavors. Gadlin (1975) states:

> Experimentation, when its relational nature is acknowledged, can become a social project rather than a laboratory exercise...The research relationship might be developed as one in which both researcher and participants mutually explore

> psychological phenomena...Among the issues it raises is the question of scientific methodology: What is it to become, or what is to become of it? (p. 1008).

In addition, reflexivity requires acknowledging that the study of human behavior includes the behavior of the experimenter; that the experimenter is as prone to psychological processes as others. This self-consciousness includes the experimenter's awareness of his relationship to his subject matter and his role with respect to his inquiry. Thus, reflexivity also involves tripartite knowledge — about the subject, the experimenter, and the knowledge itself. There is very little information in the professional journals about such matters although Habermas (1971), Ratner (1971), and Harkheimer (1972) do.

Unlike the dominant mechanistic paradigm, Anisa has developed along these lines emerging with an authentic organism-organism unit of study with means for investigating problems within that domain. The Anisa theory of pedagogy epitomizes this ideal. Using prototypical learning experiences provided in each of the Anisa specifications, with concomitant means for evaluation, the master Anisa teacher has the initial method for conducting on-going research. Viewed from the mechanistic perspective, this approach would be considered one of the "soft methodologies." Nevertheless, the method is appropriate for the subject matter. It acknowledges the role of the participant observer (H. S. Sullivan, 1953; Havens, 1976). From Martin Buber's (1958) framework, the change is from an "I-It" to an "I-Thou" relationship. It is consistent with a long line of development in the behavioral sciences and philosophical thought.

Peter G. Ossoria (1978) presents a series of works dealing with issues concerning substantive and methodological problems in the behavioral sciences. In regard to reflexivity, issues of first-person and third-person descriptions have played an important part in the history of science. Behavioral scientists have practiced on the principle adopted from the natural sciences that they must apply a transcendent "method." Great care is taken to avoid referring "subjectively" to phenomena as "my" behavior, beliefs, etc. An impersonal, third-person idiom is demanded for an objective methodology with the vantage point of a disembodied, objective observer whose own behavioral character never enters the picture. There is, however, no such vantage point. Since persons cannot have a place within "naturalistic" theories and their corresponding worlds, they have an external relation to theory. These theories are formulations of deterministic machinery which, in order to be operative, requires a person, scientist, experimenter, teacher, etc. external to the factual scope of the theory. Ossorio characterizes these theories as "the problem of the ghost outside the machine." Also, since theories are bodies of statements with no guarantee of having an isomorphic connection to the real world, no body of statements can "confer a methodological status on itself." All methodological facts about a theory lie outside the scope of the theory; thus the worlds of biology, stimulus-response, psychoanalysis, etc., have no place for "description", "explanation", "confirmation", etc. Ossorio (1978) observes:

> It is only in the real world, the behavioral world, that theories have a methodological value and a place of any

> kind. It is by persons that they are constructed, and it is for persons alone that they have some value, and it is in the world of persons alone that they can have a place. In this way, persons are the sine qua non of our 'naturalistic' theories and the corresponding 'worlds.' Persons have no place within the worlds of physics, biology, stimulus-response, psychoanalysis, et al., because it is the latter worlds which must presuppose the world of persons and their behavior in order to have a place and hence a degree of reality (p. 183).

In summary, persons are essential. Ossorio works through some of the major issues involved in the object-subject problem in the development of a truly behavioral science. Much of his work is congenial with the Anisa paradigm — it puts the person into theory. This writer, as a loving critic, notes that Ossorio's work diametrically contrasts with Clark Hull's boring hypothetico-deductive approach to learning theory. However, his work may be too informal and possibly too complex for productive practical use. His effort, nevertheless, is a significant step in the initial puzzle-solving stage of a new paradigm.

In dealing with the object-subject problem, Piaget's position is the most compatible with Anisa. Piaget (1978) notes that he has been criticized for engaging in epistemology and not scientific psychology. This is the same criticism that mechanistic science would attribute to Anisa. However, if the phenomena that is being studied is development of cognitive functions in the formation and transformations of human intelligence, then different questions are raised. For Piaget, they are, "How is knowledge acquired, how does it increase, and how does it become organized or reorganized?" According to Piaget (1978), the answers to these questions may take the following form:

> Either knowledge comes exclusively from the object, or it is constructed by the subject alone, or it results from multiple interactions between the subject and the object — but what interaction and in what form? Indeed, we see at once that these are epistemological solutions stemming from empiricism, apriorism, diverse interactionism, which are more or less static or dialectic. In short, it is impossible to avoid epistemology in movement, or genetic (psychogenetic) epistemology (p. 651).

This organismic perspective appears to resolve the mechanistic anomaly concerning object-subject relationships and the kind of research methodology that is appropriate. The "clinical method" of the Geneva group, the "soft methodologies" of action or operations research and the ecological approach of ethologists are placed in a different legitimatizing perspective. These research methods developed within this family of theories can serve as guides in the further development of the Anisa paradigm.

Means-ends. The coherence and comprehensive scope of the Anisa theories demonstrate the interdependence of the key factors discovered as anomalies. The fourth domain is concerned with the means-ends or the "is" - "ought" problem and its methodological implication. To use a broad generalization, mechanistic science is neutral and amoral; it tells you what is. It does not answer the axiological questions of value, ethics, morality, i.e., what ought to be. This is well illustrated, as noted above, with B. F. Skinner's behavioral theory. The respondent and operant theories of learning have produced powerful techniques for behavior change supported with hard empirical data. The theory, however, deals with "means" not "ends." Skinner states that his techniques could be used by both a "saint" or a "sinner." They can be instrumental in creating a better "reader", but it is a different order of question to use the theory to create the "good man."

Since Anisa deals with both efficient and final cause, it hyphenates the means-ends problem. Thus, for a necessary and sufficient explanation of development both causes are required. Given subjective aim, man is freed to some degree to take charge of his own ontological and phylogentic destiny. Based upon these theoretical propositions, a goal evaluation model would be considered an appropriate research methodology (Suchman, 1967).

A goal evaluation operations research design was used in the initial field testing of the Anisa Model in Connecticut with Project Anisa-Suffield (1973) and Project Inspire (1978). My first-hand experience as Director of Research for the two projects provides some empirical base for its appropriateness. Project Anisa-Suffield was identified as a validated project by the Department of Health, Education and Welfare in 1976; the project evaluation design was a primary factor in its validation. This methodology and empirical finding will be elaborated further in Chapter VII.

In the development of the Anisa Model, Jordan confronted the central issue in creating a theory of education — the nature of man, the basic unit of study. After establishing the first principles on the nature of man's development, the Anisa Model emerged as a prescriptive — not merely descriptive — theory of education. Since it consciously prescribes (e.g., sets goals), a goal evaluation research methodology is most appropriate. It deals with the "ought" question and places the what "is" concerns in perspective. Thus, many of the mechanistic research methods can be employed as objective means for studying efficient causal effects so that the evaluator will not deceive himself, but these means are subsumed as a special case in a larger value system. Anisa, as a behavioral science, truly places man — the "person", the "knower" — in the transcendent, active-organism role of determining his own destiny. In addition, there is purpose to that destiny. It is a science not only of the individual but also of mankind. It plays a key role as a new paradigm among the sciences because it explains and prescribes the operations used in the development of all sciences.

Time. The Anisa paradigm sheds some insights on the fifth identified anomaly — time. As discussed previously, Einstein resolved the mechanistic science view of time as being an absolute by establishing time as relative, reflected in a hyphenated space-time continuum. This replaced Newton's concept of time as an absolute where motion is a measure of time. The Anisa view is more consistent with Einstein; time is a measure of motion. Anisa theory conceptualizes time as inherring in process. Since Anisa, as a cosmology, is consistent with the "big bang" theory in physics, we have an evolutionary view of the universe with man as the "tip of an ever-ascending arrow." The full meaning of this view of time is yet to be understood.

One aspect with regard to research methodology, however, is that it makes meaningless the view that the experimental findings for mechanistic science fulfill the criterion of being "time independent."

This is the major crisis faced by social psychology (Gergen, 1973). When viewed through the organismic perspective with an emerging universe, a very different concept of reality and time is required. There will be a further elaboration of methodological issues in Chapter V where their implications for an emerging new paradigm will be considered.

As a further elaboration of the Anisa paradigm, its theoretical matrix will be presented. A paradigm's theoretical matrix as Kuhn observes, is the usual framework used for communication among scientists.

Theory. To function as a scientist it is not enough to have a good theory and sound data, for the heart of the scientific approach is the constructive interconnection between them. Jordan presents such a systematic conceptual scheme which calls for correcting, revising, and expanding theoretical conceptions in response to data from empirical studies. This relationship between theory and data is schematized in Figure 3. The theory of evaluation has a key role in this matrix; the primary focus of this study will demonstrate the integral relationship of the theories of administration and evaluation.

INTERCONNECTIONS BETWEEN THEORIES AND EVALUATION DATA

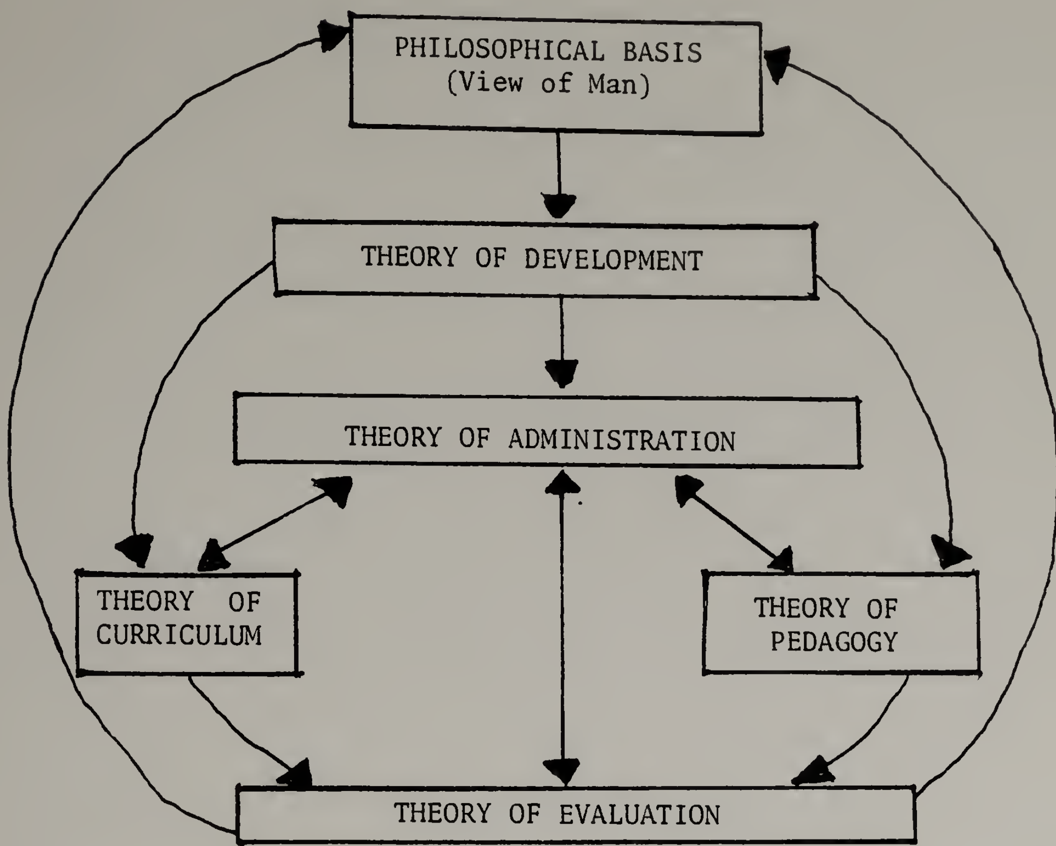


Figure 3. Conceptual Framework of the Anisa Model (From Jordan & Streets. Unpublished Manuscript, 1972.)

Oliver Heaviside, a theoretical physicist, wrote:

> Facts are of not much use, considered as facts. They bewilder by their number and apparent incoherence. Let them be digested into theory, however, and brought into mutual harmony, and it is another matter. Theory is the essence of facts. Without theory scientific knowledge would be only worthy of the madhouse (Heaviside, 1950/1891).

Jordan also holds that science is more than knowledge (facts); more than a method. It is organized knowledge that can be used.

Toward that end, Jordan developed five theories: (1) Theory of Development, (2) Theory of Curriculum, (3) Theory of Pedagogy, (4) Theory of Administration, and (5) Theory of Evaluation. They are presented and articulated in usable form. While they are deduced from the paradigm's basic presupposition, they are not developed in the ponderous hypothetico-deductive approach that some textbooks hold as the pinnacle of scientific method and falsely represented as the way great work in the mature sciences is conducted. Jordan's more "informal" approach is more characteristic of how truly great science is done. It contrasts diametrically with the formal hypothetico-deductive learning theory developed by Clark Hull which has been most unproductive and ponderous to work with (as are most physical theories postulated in propositions and corollaries). Each Anisa theory serves to organize knowledge within its domain; the integral relationship of one theory to another is the basis for its coherence and comprehensiveness. For the practitioner (teacher, administrator, et al.) it is organized in usable form; it is also a self-generative model. The key element is the theory of evaluation which is the empirical base for the paradigm. Thus, while the paradigm (theory) determines the selection of legitimate data, data too, should serve to shape theory. There is a reciprocal relationship not always evident in the behavioral sciences. This process is analogous to the growth of knowledge in both Piaget's and Kuhn's perspectives. In Bateson's (1979) terms, "Science probes; it does not prove."

Assimilation of old facts. The Anisa presuppositions concerning the nature of reality are able to assimilate many theoretical schools of educational thought; therefore, it is the thesis of this work that it is also instrumental in moving education out of its philosophical preparadigm status. Since it represents a paradigm shift, it also assimilates many of the old mechanistic "facts" discussed above. As a great theoretical synthesis, it incorporates and integrates many educational practices that have developed over the last one hundred years of American education.

New applications. At this stage of paradigm development, it is still premature to fully predict new applications of the Anisa paradigm. The greatest possible new application, however, appears to lie in the behavioral sciences. Historically, education in its attempts to become a profession (practice based on a scientific knowledge) drew heavily upon the behavioral sciences, particularly psychology. The latter was the only behavioral profession to develop on a scientific footing, patterning its science on mechanistic physics. Because of the crisis in social psychology and psychometrics, Anisa, as a new paradigm, has the possibility of making a significant new application to the behavioral sciences.

The organismic position regarding biological research and practice will also offer significant new applications. The Anisa emphasis on the role of nutrition in releasing biological potentialities places in a new perspective optimum biological integrity as a basis for optimum learning. Pediatrics will be more concerned with optimum biological development, as Herbert Birch noted, and not merely with survival.

Anisa operationalizes the concept of learning-to-learn which has new applications in the domain of epistemology. The Anisa paradigm represents a process which conceptualizes the growth of knowledge itself. As Bateson (1979) demonstrates, the organismic position leads to a necessary unity between mind and nature.

There is a clear analogy between Piaget's view of the development of intelligence and Kuhn's concept of the growth of knowledge. These concepts closely parallel the Anisa position. This epistemological concern can be illustrated by an example of what Piaget calls "schemes of action" or simply "schemes." Thus, the infant is elaborated by practice into patterns of movement that we can call sucking and grasping reflexes which remain hardly changed over a period of time. The infant applies each "scheme" to everything he can; everything suckable within reach is sucked, everything graspable that comes to hand is grasped. Every time a scheme is applied to a new object, the scheme itself is slightly affected, becoming more general.

Intelligence for Piaget is the total of coordinated schemes, and it grows by its own exercise. It constitutes an organ of adaptation, operating in two complementary ways — assimilation and accommodation. The use of a scheme is assimilation; the modification of a scheme to fit new objects is accommodation. By use, schemes become more abstract and interiorized. There is no role for the stimulus and response concepts as separate entities; the schemes operate as a unity. There is no environment except as the organism has a structure prepared to react to it. The only objects that exist are those for which he has a scheme.

Piaget's "equilibration" refers to the inner logic or deep structure of the stages of development. Thus, certain periods of development have an inner, self-sustaining coherence — called a stage. Other periods are intrinsically unstable and are considered transitions.

There appears to be an analogous relationship between Piaget's concept of the development of intelligence and Kuhn's concept of the growth of knowledge — one has an ontological perspective, the other phylogenetic. The "normal science" stage of a paradigm, focused on solving all the legitimate problems the paradigm indentifies, is analogous to the behavior of an infant who applies his sucking and grasping schema to all problems. Piaget's "equilibration" is analogous to Kuhn's "normal science" stage; the processes of "assimilation-accommodation" are analogous to the "anomaly-paradigm shift" stage.

These new applications of Anisa to understanding the growth of science (knowledge) are yet to be grasped. The problem, nevertheless, centers on the nature of "science" which has been "dualistic." In Western thought, there has been a dichotomy between subject and object — observer and observed. The physical sciences served as a prelude to the current view represented by Anisa in which man — life itself — is now the unit of study. Thus, Anisa as a science is concerned with understanding the human mind — that is, of the observer. Artificial

Intelligence research dating back from Pascal, Leibniz, Boole, and Babbage to the present sophisticated computers that can "think" are the furthest steps in this direction. Following this step may be the self-application of science, i.e., science studying itself as an object. Piaget's and Kuhn's efforts appear to be in that direction. There will be a further explanation of this in Chapter V.

At this very early stage of development of Anisa as a scientific paradigm, there are no data to elaborate the following phases: new small discoveries, anomalies, theoretical crisis, and extraordinary science leading to new presuppositions and grand discovery. For a simplified overview, Figure 4 presents Kuhn's scheme as applied to Anisa. While there are other ways to conceptualize the growth of scientific knowledge, for the purposes of this study, the Kuhnian framework has provided some conceptual order to understanding the very complex phenomena of scientific development.

Summary

The Anisa Model is viewed within Kuhn's structure of the growth of science. Illustrations from the growth of the mature physical sciences were presented demonstrating the following processes of growth: presuppositions, exemplars, normal science, puzzle-solving, anomalies, extraordinary science, and paradigm shift. Anisa, when compared to these processes, fulfills Kuhn's criteria for a scientific paradigm. It was shown how Anisa moves education out of its pre-scientific philosophical status to a dual paradigm science. A scheme for scien-

Presuppositions	Grand Discovery	Method	New Applications	Anomalies
- Change: a universal constant which presupposes potentiality. - Explains how potentiality is actualized at biological and psychological levels.	-Learning: ability to differentiate, integrate, and generalize aspects of experience — primary exemplar.	-Goal Evaluation -General Systems Operations Research -Ecological Approaches	-Basis for a behavioral science. -New epistemology.	
		Theory	**New Small Discoveries**	**Theoretical Crisis**
		-Theories: Development, Curriculum, Pedagogy, Administration and Evaluation	-New testing technology -Theory of teaching as a new research methodology.	
		Assimilation of Old "Facts"		
		-Causation (Efficient-Reciprocal) -Holistic-Reductionist -Object-Subject -Means-Ends -Educational practices		

Figure 4. Scheme of Scientific Revolutions: The Anisa Paradigm

tific revolutions was presented, illustrating the paradigm shift from Newtonian physics to Einstein's general theory of relativity. The crisis of the mechanistic paradigm was demonstrated by documenting anomalies in linear causation, reductionism, continuity, and time. It was shown how Anisa was able to assimilate these anomalies, thus representing a major shift from a mechanistic to an organismic paradigm.

Viewing Anisa in relationship to Kuhn's perspective should help to provide insights and understanding for the professionals committed to developing Anisa as an emerging new paradigm for education.

The first three chapters established criteria for assessing any empirically based scientific theory. These criteria can be used, therefore, to assess a range of theories consistent with mechanistic science. The growth of scientific knowledge following Kuhn's paradigm perspective, however, offers a more comprehensive framework for understanding science. The application of these criteria to the Anisa Model will now be demonstrated as a specific case in point.

CHAPTER IV

ANISA MODEL AS A SCIENTIFIC THEORY

The purpose of this chapter is to illustrate the application of criteria for assessing scientific theories specifically to the Anisa Model. Within the Kuhnian paradigm perspective, Anisa will be presented first as a disciplinary matrix. It will be demonstrated how Anisa fulfills each of the three fundamental steps of the scientific process (i.e, observation, model building, and ability to generate new and testable hypotheses). Second, in the growth of scientific knowledge, Anisa will be presented as an example of "extraordinary science" resulting in a comprehensive, coherent scientific theory of education. Using Kuhn's scheme of scientific revolutions, as illustrated in Chapter III, it will be demonstrated how Anisa, representing a paradigm shift, now moves into the "normal science" stage of paradigm development.

Observation: Units of Study

Since scientific models are the creation of an inventive mind, it will be helpful in understanding the Anisa Model to discuss briefly some of the influences that have shaped the inventor's view of reality. Daniel C. Jordan, a Rhodes scholar, epitomizes C. P. Snow's "two cultures." He has earned three degrees in music — two from Oxford in composition, theory and the history of music. He holds two advanced degrees from the University of Chicago in an interdisciplinary course of study involving human development from biological, psychological and anthropological perspectives. Post-doctoral study involved brain chemistry and its relationship to memory and learning. These influences contributed to his bridging the two cultures of art and science. He characterizes Kuhn's observation about men who have invented new paradigms; they are either very young or new to the field and not fully committed to the traditional rules permitting them to be freer to conceive of another set. Professor Jordan became aware of gaps between theory and practice in education. He believed that education was dominated more by practice than theory. There was no organized knowledge about human growth and development that could be optimally used for practice by teachers.

His initial conceptual efforts began over eighteen years ago as Director of the Institute for Research in Human Behavior at Indiana State University. Initially, Jordan observed that educators were more concerned with curriculum and not the nature of the child for whom it was designed. Very early on, therefore, Jordan selected his basic unit of study — man. Toward that end, he studied man's best thinking about the nature of man reviewing all major philosophiers from Parmenides to the process philosophers of today.

Over a ten year span, Jordan reviewed the most significant philosophic works as the basis for theory construction. The organismic philosophy of Alfred North Whitehead generated the best framework for analyzing and synthesizing knowledge about human growth and development, including the concept of purpose. In order to design a new edcuational system that is coherent and comprehensive (i.e., to be able to unite every aspect of human experience) required a philosophy that held promise for a new idiological base. Whitehead (1969) believed that "philosophy is the endeavor to frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted (p.21)." His process philosophy, which is integrating and all-inclusive, nevertheless, keeps any system open to new data with no claim that his system is final. Whitehead's system is a synthesis of both Eastern and Western streams of thought. However, it is not eclectic; the synthesis was seen as providing the basis for an educational model with cross-cultural implications.

Hartshorne (1950), currently the most outstanding process philosopher, makes the following observation on Whitehead's philosophy:

> ...one may say that the basic principles of our knowledge and experience, physical, biological, sociological, aesthetic, religious — are in this philosophy given an intellectual integration such as only a thousand or ten thousand years of further reflection and inquiry seem likely to exhaust or adequately evaluate...(p. 19).

Jordan in his review of the major philosophers, therefore, discovered an organzing principle for a science of education in specific form from the cosmology of Whitehead (1929), Process and Reality. For Whitehead, the most pervasive characteristic of the universe is change. Change means process, and process presupposes potentiality. This for Jordan served as his first principle; the concept of process as the translation of potentiality into actuality.

As noted in the Introduction (p. 1), Jordan viewed science as more than knowledge. A science of education could not be created until the massive information available about human growth, development, learning, and behavior could be organized into usable form. Jordan found such a principle in Whitehead's concept of process; this provided him with a basis for deriving a set of concepts which could be used to organize current knowledge about human development. This offered the possibility of translating it into a coherent body of theory which could serve as the substantive body of knowledge for professional educational practices. With such an empirical scientific footing, educational practices could be evaluated and continuously refined. Analogous to medical practices, which are based on the biological sciences, education could then make more accurate predictions with a consequence of improved accountability.

Jordan and his colleagues in establishing a coherent body of theory that addressed all aspects of education (i.e., human development, curriculum, pedagogy, administration, etc.) attempted to test every newly developed theoretical concept against relevant empirical studies available from the literature of the biological and behavioral sciences. Based on this broad philosophical and theoretical foundation, the beginning of a comprehensive and coherent model of education was generated.

Using the criteria for assessing scientific theories established in Chapter I, what specifically are the units of study upon which the Anisa Model is based? Initially, Jordan selected "man" as his basic unit of study. Since man, according to Whitehead, is at the apex of a hierarchically organized universe, he is also an integral part of the universal process of change. Therefore, at the highest level of abstracting, the basic unit of study is change itself — the process of translating potentiality into actuality. These energy transformations range from the micro to macro units (i.e., the physical, biological, psychological, social, and spiritual). Since it involves the physical, human, and unknown environments, including the self as both object and subject, it encompasses the totality of the "proverbial elephant." Holding an organismic as opposed to a machine view of reality, it is also concerned with emerging hierarchic organizations, discontinuities and time. As noted above (p.122) the units of study, in other terms, involve the full spectrum of thing-thing, organism-thing, organism-organism, organization-organization interactions. It deals, therefore, with the reductionist problem within a general theory of organization involving a total cosmology, evolution, and epigensis. The terms comprehensive, coherent, and empirical are, therefore, appropriate.

Model Building

Haivng established the units of study in the first observation stage of the scientific process, the second stage is concerned with model building. Jordan used language as the basic symbol system in developing his theoretical model. In the process of model building the three components of data language, assumptions, and testable hypotheses are now the focus for evaluating the Anisa Model. While these are presented in linear order, the actual process of creation involves a strong interrelationship between the development of a precise data language and making explicit the underlying assumptions. The actual process that Jordan used, however, appears to have reversed the linear steps for he was most concerned with the second (i.e., the search for an organizing principle). What Jordan refers to as the first prinicple is equivalent to the term "assumption." In further evaluating Anisa as a scientific theory, therefore, I shall address its underlying assumptions first and then deal with its data language in explicating its respective theories.

<u>Assumptions</u>. The implicit or explicit assumptions of a theory are those premises that are taken to be true for the purpose of developing or testing the theory. The term assumption, therefore, refers to principles assumed to be true without necessary empirical verification as part of the theory. Again, for the Anisa Model these are equivalent to its first principles.

What are the assumptions (first principles; the presuppositions) of the Anisa Model? While there are different levels of assumptions, at the most general level the explicit basic assumption underlying the Model is the universal constant of change. As developed above (p.122) change means process, and process presupposes potentiailty. The concept of process as the translantion of potentiality into actuality serves as the Model's explicit assumption — its first principle (presupposition).

Whitehead (1968) states, "existence (in any of its senses) cannot be abstracted from 'process'." The concepts of process and existence presuppose each other. He further states,

> The notion of potentiality is fundamental for the understanding of existence, as soon as the notion of process is admitted. If the universe be interpreted in terms of static actuality, the potentiality vanishes. Everything is just what it is...if we start with process as fundamental, then the actualities of the present are deriving their characters from the process, and are bestowing their characters upon the future. Immediacy is the realization of the potentialities of the past, and is the storehouse of the potentialities of the future...the potentialities in immediate fact constitute the driving force of process (p. 96).

In order to understand the nature of process, it is necessary to understand how potentiality becomes actualized. The principle of process maintains that the being of an entity is constituted by how it becomes; thus, the reality of anything is its becoming. It implies, therefore, that no individual can be described in static terms. When a child is actualizing his potential, new powers are becoming which sustain the process. The implications of this should have a great impact on causing the re-examination of our norm-referenced testing and evaluation procedures which label and lock children into fixed categories. It is notable that the actualization of one's potentialities brings satisfaction. Whitehead (1968) states, "The process of self-creation is the transformation of the potential into the actual, and the fact of such transformation includes the immediacy of self-enjoyment (p. 117)."

Closely related to the "principle of process" is the "principle of relativity." It derives the explanation of the process of becoming from the general ontological principle of relativity. Everything in the universe, for Whitehead, is interdependent (i.e., man's relatedness to all other entities in the universe and the impossibility of understanding any being apart from the circumstances in which it becomes).

Whitehead (1969) describes creativeity as "the universal of universals." It is the process whereby "the many become one and are increased by one." Hartshorne (1972) clarifies this further,

> Each human experience is 'one' a new singular actuality not hitherto present in reality. But each experience prehends a multiplicity of data (the 'many'). Thus there are memories of preceding experiences of man himself, there are prehensions of unit-events in parts of the body, etc. Many actual entities (each pulse of existence) furnish data for any one new actual entity. Accordingly, the entity is a 'synthesis' of the world out of which it arises. The synthesis cannot be causally predictable, except approximately, because it is a subtle contradiction to suppose that many things could dictate their precise mode of inclusion into a synthesis (p.175).

This view of creativity is synonymous with development, the actualization of potentiality. Every advance or increment creates a novel entity.

In defining the nature of man, Jordan accepts the assumption of hierarchical structuring as the primary expression of order and beauty in the universe. The order of the universe is defined in terms of different hierarchically arranged ontological levels with man at the apex of all living creatures. Whitehead sees man in the world, yet standing apart from it by his capacity for conscious awareness of himself and the world. Man encompases the lower levels of nature but possess the ability to think, to be introspective, to think about himself, and to think about himself thinking. Man can contrast "what is" and what "might be." Whitehead considers consciousness as the subjective form of this feeling of contrast. This "contrasting" capacity of consciousness permits man to deal with factors that may frustrate his subjective aim or purpose.

The quality of man's consciousness depends on his cumulative experiences preserved by memory (a form of immanence), and on subjective aim or purpose, the means by which the future dwells in the present (a form of transcendence). Jordan and Streets (1972) define "immanence" and "transcendence" as follows:

> Immanence is reflected in the ability to mold out of the past a dynamic present; transcendence is using the present to extract from the past what will enable one to move beyond himself into the future. It is a basic ontological principle of the philosophy of organism that a being in the present is created out of its own past as it incorporates new data from the environment; everything emerges out of something which exists previously. Thus, each man at any given point in time is a summation of his past (p. 11).

The characteristics of immanence and transcendence make man a spiritual being. Spiritual is used in the psychological sense as the conscious capacity to structure and to interact with the unknown by responding to non-actual realities such as ideals, aims, purposes, and theories. Man can accept the ideals or theories as substitutes of the unknowns and give them symbolic expression which helps to give direction to the translation of potentiality into actuality facilitating their functiong as final cause. Man, therefore, is a spiritual as well as a material being who asprires to ideals, formulating goals consistent with them, attains those goals and formulates new ones.

In the process of becoming, there is an intrinsic pressure to know and to love. This results in a conscious speculation and attraction to unknowns and unknowables and man's relationship to them. Whitehead also introduces the "subjectivist principle" that everything is in part determined by its own internal state. It acknowledges external causation (efficient) but these causes do not fully determine the behavior of any given entity. In man, consciousness and the capacity for symbolization allow him to store information in memory, make plans for the future, and so affect what he will become. The subjectivist principle in man is translated into subjective aim or purpose or intentionality. As he is to a larger degree freed from efficient causation (instinct), the role of learning is increased as he takes charge of his own ontological and phylogenetic destiny. Jordan conceives of order as dynamic in nature with novelty emerging from new integrations. As noted above, man escapes the limitations of materiality by his ability to direct the process of his own becoming — through learning he patterns the use of available energy — by consciously entertaining the possibilities (potentialities) open to him.

The model deals with the direction human potentiality may take in relationship to ontological levels of the universe. This is accomplished by defining the nature of environments. Thus, in addition to the universe being characterized by change, it is also characterized by ontological levels, hierarchically organized. Jordan and Streets (1973) define environments as follows:

> The physical environment — which includes everything except human beings (mineral, vegetable, and animal); the human environment — which includes all humans...; the environment of the unknown and unknowables — the ultimate mysteries in the cosmos of which consciousness enables us to be aware, even if we do not know what constitutes them; and the Self — a reflection of the above three environments in a particular human being(p.33).

Each level is known by its particular attributes. The mineral level attributes involve its inorganic nature and cohesion; the vegetable level incorporates the attributes of the mineral but adds reproduction and growth; the animal level possesses the vegetable attributes and adds sense perception, movement, and ability to learn; the human level includes all the lower level attributes and adds conscious intelligence and reflection, the ability to acquire knowledge (e.g., scientific and artistic), and the capacity to consciously care (love).

Polanyi (1969) developed a theory of boundry conditions defining the laws governing each organizational level. The term boundry conditions is borrowed from physics which is explained as follows:

> The theory of boundary conditions recognizes the higher levels of life as forming a hierarchy, each level of which relies for its working on the principles of the levels below it, even while it itself is irreducible to these lower principles...Each (level) reduces the scope of the one immediately below it by imposing on it a boundry that harnesses it to the service of the next higher level, and this control is transmitted stage by stage down to the basic inanimated level (pp. 233-234).

Awareness of boundry conditions provide a better understanding of the nature of environments by delimiting the significant range of potentialities in each one, and prevent errors of logical typing (see Chapter V) by not making inappropriate extrapolations from lower to higher levels.

Environments are, therefore, related by their hierarchical organization. Every creature belongs to one or more levels and is thereby connected to all levels. Man's interaction with each environment may enhance or suppress his development. While man may have the possibility of infinite development, destruction is also a distinct possibility. Huxley (1967) states:

> Man's destiny is to be the world's senior partner, the primary agent for the future evolution of this planet. This applies both individually and collectively, both in the short and in the long term. In him, the evolutionary process has finally become conscious of itself. This is a unique privilege, but also a formidable responsibility which gives him dignity, but which he cannot unload on the shoulders of God or Fate (p. 35).

While it is a possiblity, man's interactions with the environment need not destroy their inherent order and beauty. Whitehead (1967) maintains that, aesthetically, the hierarchical organization of the universe reflects both order and beauty.

> The teleology of the Universe is directed toward the production of Beauty. Thus any system of things which in any wide sense is beautiful is to that extent justified in its existence. It may, however, fail in another sense, by inhibiting more Beauty than it creates. Thus the system, though in a sense beautiful, is on the whole evil in that environment (p. 265).

From these prespectives man is at the apex of evolutionary processes. Understanding the nature of process, environment and man underscored the importance for Jordan of establishing first principles as the basis for a theory education.

Once the basic assumptions (first principles) were established, Jordan generated a universal model of education which is comprehensive, coherent, and scientific in its foundations. Since the conceptual base of the model rests on the work of process philosophers and is organismic in nature, Jordan called the model Anisa. The word comes from a Greek root word that refers to an ancient symbol, the tree of life.

In the process of theory building, therefore, Jordan not only made explicit his basic assumptions but made them the foundation upon which he deduced a comprehensive and coherent theory. His basic assumption (concept of process as the translation of potentiality into actuality) leads to an organismic as opposed to a mechanistic view of the universe — the basis for a paradigm shift. The basic metaphor is the living organism — an organized and dynamic whole. It represents the active organism model of man who, because of subjective aim and final cause, is inherently active and self-directing rather than activated by external efficient causes only.

With respect to fulfilling the scientific criterion of having explicit assumptions, Anisa fully meets this criterion. In fact, every effort was made to articulate the basic assumptions before further theory construction. Jordan then formulated the body of theory derived from the basic assumption which include theories of development, curriculum, pedagogy, administration, and evaluation, each of which is briefly presented below.

Data language. Since these theories are imagined mental contructs invented to explain observed phenomena, their primary function is to help understand the world. Jordan uses language as the symbol system to represent the underlying structure of the real world that he is conceptually mapping. The particular focus of this presentation is to assess the theories with respect to their demonstrating the criterion of a precise data language. Is the data language defined as precisely as possible with referents in the "real world?" It is important to caution that the terms used need to be considered within the organismic paradigm. As Kuhn has noted, terms from one paradigm to another are incommensurable. This should be considered since Anisa represents a new paradigm for education. It is also desirable to use the criterion of a clear data language which is internally consistent with the new paradigm.

Theory of development. The Anisa theory of human development defines development in terms of the first principle, as the translation of potentiality into actuality — an epigenetic process initiated and sustained by the individual's interactions with the environment. Development refers to change in an organism from one state to a more complex and integrated state of organization both physiologically and psychologically that is orderly, progressive, cumulative, irreversible and rhythmic. The theory specifies two basic types of potential — biological and psychological — and states that interaction between the organism and specific environments determines which potentialities become actualized, and how the actualized potentialities will be structured to form character, identity, and personality.

The key factor in the actualization of biological potentialities is nutrition — the translation of the genetic code into living tissue. The theory calls for application a year before conception to provide the prospective parents with proper nutrition that will make them as healthy as possible in preparation for conception. During pregnancy the mother's diet is carefully monitored. Empirical evidence has demonstrated a connection between the nutritional status of the child and his ability to learn. Since learning is the means by which psychological potentialities are actualized, a necessary condition for optimal learning is the provision for proper nutrition.

The theory of development sets forth five basic types of psychological potentialities — psychomotor, perceptual, cognitive, affective, and volitional. The key to the actualization of these potentialities is learning. Since learning — the exemplar for the Anisa paradigm — is a key term, Jordan (1979) defines it as follows: "Learning is defined as the capacity to differentiate experience by breaking it down into contrastable units, to integrate these elements in novel ways, and to generalize the integration to other similar situations." In addition, learning "...sets forth the proposition that differentiation, integration, and generalization constitute a trio of interrelated processes that defines a developmental unit of change — a stage (sequences of stages being the primary means by which increasing complexity of function and structure is built up and integrated through hierarchical organization)." (Jordan and Shepard, 1972). As discussed in Chapter V, each stage also represents a change in logical typing.

Within this framework, whenever a student manifests a learning problem, it is because he has a nutritional deficit that is impairing learning or because he is failing to differentiate, integrate, generalize, or because of some combination of all these factors.

Learning competence — knowing how to learn — is the conscious ability to differentiate, integrate, and generalize. The five categories of psychological potentialities are defined as follows: Psychomotor competence is an inner awareness of all the muscles which can come under voluntary control. The various movements of the body parts can be differientiated and integrated into patterns of movements which express the purposes of the individual.

Perceptual competence refers to the conscious ability to differientiate sensory information (vision, auditon, olfaction, etc.) and integrate that information into generalizable patterns that constitute interpretations of reality enabling the individual to make decisions and act on the basis of that information.

Cognitive competence refers to the conscious ability to think and reason. An individual comes to know something by acting upon it. The interactions from this process are the basis for the development of internal structures in the brain that form the basis for cognitive competence.

Affective competence is the conscious ability to differentiate affective states that reflect the viability of the individual, to integrate them so that they accurately inform the individual of his viability. Affective competence involves the differentiation of feelings — balance of the hope and fear related emotions — and their integration in reference to objects, events, people, or ideals, and their generalization in ways that provide some stability in life.

Volitional competence is the conscious capacity to form ultimate aims, differentiate them into operable goals and integrate them into a flow of intentional behavior. The role of purpose or subjective aim, is an important factor in the translation of potentiality into actuality. It enables man to achieve control over his own destiny. Some of the processes that relate to the development of volitional competence are attention, goal setting, self-arousal, perseverance, effecting closure and fantasizing a state of goal attainment.

The separation and distinction among the different categories of psychological potentialities was made only for the ease of understanding and fostering a specific dimension of development; it is fully understood that every act of experience will involve all five categories, each to a greater or lesser extent. The theory affirms the importance of early experience in shaping subsequent development and states the hueristic value of critical or sensitive periods, stages and sequences. The theory also affirms that development as a whole is sustained through interaction with the environments. The quality of the environments, therefore, influences the quality of the interactions which influences development.

The theory accounts for the importance of introducing some degree of novelty into the environment as the basic means of creating disequilibrium between developmental level and experience which forces new patterns of interaction that facilitate the actualization of psychological potentialities. It explains the emergence of character development in terms of value formation defining values as the relativity enduring structurings of actualized potentialities — patterned uses of energy.

The theory identifies three value sub-systems (material, social, and religious/aesthetic) which are associated with each of the three basic environments — physical, human, and unknown, respectively. It explains the higher-order competencies (technological, moral, and spiritual/philosophical) which are built on the above value sub-systems. It defines the reality of personal identity — the Self — as the three value systems combined into an integrated totality resulting in self-competence which is the combination of the higher-order competencies.

The theory provides the basis for undertanding pathology and its etiology — biological and psychological. It identifies the conditions for the prevention of mental illness and deliquency, and can generate testable hypotheses concerning therapy and rehabilitation.

Theory of curriculum. The primary purpose of the Anisa Model is to actualize human potential at an optimum rate. In order to help accomplish this purpose, Jordan developed a comprehensive theory of curriculum and a theory of pedogogy which are interdependent and coherent with the theory of development directly related to the categories of potentialities. The theory defines curriculum as five sets of objectives and delimiting what the students with the assistance of teachers must do to achieve them (Jordan, 1979).

The first is concerned with the achievement of learning competence in the five psychological potentialities. Learning competence, again, is the conscious ability to differentiate, integrate, and generalize experience. These objectives constitute the process curriculum (i.e., the learning-to-learn part of the curriculum). Specifications are written for each potentiality identifying activities needed to achieve them. Cognitive processes, for example, involve classification, seriation, conservation, transitivity, deduction, analogy, etc. The process curriculum integrates all other aspects of the curriculum.

The second set of objectives are concerned with the content curriculum. This provides the basic information about the world organized according to the ontological levels: physical, human, and unknown. The content curriculum, therefore, is organized in a similar fashion to the traditional, i.e., the physical sciences, behavioral sciences, and philosophy/theology, respectively.

The third set of objectives is concerned with the mastery of three basic symbol systems: mathematics, language (speaking, reading, writing), and the arts (music, drama, visual). These symbol systems are the secondary means of integrating the entire curriculum.

The fourth set involves three types of higher-order competencies and values related to environments. The value systems and related competencies are as follows: (1) material values and technological competence result from interactions with the physical environment,

(2) social values and moral competence result from interactions with the human environment, and (3) religious and fiducial competence result from dealing with the unknown and unknowable environment. Jordan refers to these values as religious because one can approach an unknown only on faith. Fiducial competence "...is the ability to activate faith as one pursues an unknown so that the anxiety from risk involved can be managed by turning it into courage." These values and competencies are, therefore, the combined effects of the process and content curricula.

Actualized potentialities are structured — expressions of energy use called values. Thus, a value is defined as a relatively enduring patterned use of energy. The integration of the three value systems is the basis of personal identity. Since each value is organized around an ideal, the ideal for material and technological competence is physical causality (efficient causation of thing-thing interaction); justice is the ideal for social values and moral competence; and, "unity/truth/beauty the trinity of ideals for religious values and fiducial competence."

The Anisa Model is a prescriptive theory; it deals with both means and ends. A "value-free" education, therefore, is rejected as being impotent and aimless. It differs from the mechanistic view which deals only with means and is amoral or neutral concerned primarily with "what is." Anisa takes a stand on the issues of values, ideals, and higher-order competencies since human beings demonstrate the capacity to create ideals that serve as lures for the structuring of energy use. The prescriptive nature of the Anisa paradigm deals with the "ought" issues (final cause) and subsumes the value-free "what is" (efficient cause) issues as a special case.

The fifth set of objectives are concerned with the self. The goal of this curriculum is self-knowledge which permits the conscious translation of potentiality into actuality resulting in an integrated value system — personal identity. The curriculum is organized around the process curriculum; thus, body awareness (psychomotor development), self-percept (perceptual development), self-concept (cognitive development), self-worth (affective development), and self-determination (volitional development). These are integrated around a self-ideal representing the person's material, social, and religious values as these values, however, pertain to the self. Jordan (1979) observes, "...justice is the ideal around which social values are organized to yield moral competence. On the level of the self-ideal, this is reflected as fairness; every self-ideal will include a commitment to fairness to some degree."

Theory of pedagogy. The theory of teaching also takes its definition from the theory of development. The process of translating potentiality into actuality is accomplished by interaction with the environment and the primary role of the teacher is to facilitate that process. Teaching, therefore, is defined "...as arranging environments and guiding the child's interaction with them to achieve the goals specified by the curriculum." The theory asserts the need to individualize instruction and specifies how this will be accomplished by (1) diagnostic and speculative methods for determining the developmental level of the child and (2) prescribing or experimenting by arranging environments and guiding interactions so that the experience matches the developmental levels of the child on any dimension related to a particular objective specified by the curriculum.

"Match" is defined as the optimal disparity (novelty) between internal schemata and the learning experience that is being provided. Curiosity is the best indicator of the tension inherent in optimal disparity; it is an important source of intrinsic motivation to be facilitated by the teacher.

The theory emphasizes the significant influence the teacher has as a model. Provides for coordination of staffing patterns so that children have several adults who know them and preferably over a three or four year period of time. Provides for the more experienced children to teach the less experienced throughout the system.

Theory of administration. Defines administration in terms of service qualified by the goals of organization as specified in the theory of curriculum. Identifies two basic functions of administration — leadership and management — which are in dynamic equilibrium. Leadership deals with the present in terms of future possibilities (transcendence); management is concerned with the present by coordinating resources representing past accomplishments and accumulated knowledge (immanence).

The Situational Leadership as developed and operationalized by Hersey and Blanchard (1972) is most congenial to the Anisa theory of administration and serves as the leadership and management system at the present Anisa field-testing sites in Connecticut. This is elaborated further in Chapter VII.

It is beyond the purposes of this study to delimit fully the theory of administration but merely to indicate its dimensions and integration as an interdependent theory. It is in an orchestrating position for implementing the Model. It emphasizes the rational basis for institutional self-renewal by making the results of research and evaluation mandatory input for the decision-making process. The theories of administration and evaluation are viewed as integral systems.

Theory of evaluation. This dissertation is a further elaboration of the Anisa theory of evaluation. Some of the initial concepts will be noted. Evaluation is defined in terms of the purpose of the activity or program being evaluated. Thus, the integral relationship to administration which has the primary responsibility for goal setting as prescribed by Anisa theory.

The theory seeks to relate means to ends, distinguishing efficient from final causes. Conceives evaluation as an on-going process concerned with every aspect of the program — formative and summative. Provides for a circular, causal, and feedback process for timely modification, including modification of the evaluation design itself. Emphasizes the importance of longitudinal studies and guards against ready acceptance of short-term effects as proof of impact.

The primary focal point of evaluation is the analysis of children's interactions with particular environments and their developmental consequences — in essence, evaluating the effects of the theory of teaching. In this process, it recognizes internal states of the individual (such as subjective aim, intentions or memory) as causal factors on behavior. Uses evaluation findings as basis for re-examination of the assumptions (first principles) underlying the Model and the theories on which its operationalization depends. Views the purpose of evaluation with the explanatory and predictive functions of research and science.

In general, how adequate is the data language in Anisa? How does it compare with other education theories? The definitional terms in Anisa deal with the fundamental components of the educational process (e.g., learning, development, teaching, curriculum, administration). The definitions are coherent and straightforward. A notable contrast with definitions found in many of the current educational theories, however, is the fact that their definitions are closely linked to illustrations. For example, the concepts of "differentiation" and "integration" would generally be defined with reference to a number of specific behaviors illustrating each. There are, nevertheless, potential advantages and disadvantages for defining key theoretical concepts in an abstract rather than a concrete way. The potential disadvantage is that teachers, administrators, and parents will be unclear about the meaning of the key terms without specific concrete referents. The important advantage, however, is that the concepts can be applied to a very broad range of levels and problems. This is analogous to Newton's exemplar of force is equal to mass times acceleration (f = m x a); the abstract formulation permitted engineers to apply the concepts to a wide range of matter in motion from pendulums to matter in free fall. This same abstractness contributes to Anisa as a "generative theory", which provides the theoretical basis for each teacher to generate a learning situation for students rather than relying on a fixed "recipe" approach. The teacher, therefore, continues to learn-to-learn and serves as a model for the students who in a reciprocal process also learn-to-learn.

Testable hypotheses. While the Anisa Model demonstrates a precise data language and explicit assumptions, to qualify as a scientific theory it must also fulfill the criterion of being able to generate new and testable hypotheses. The scientist moves from theoretical hunch land to the land of verification by employing experimental designs that can be empirically tested in the real world. If they are not verified, the theory is either abandaned, modified, or a new theory is developed.

What are the new and testable hypotheses generated by Anisa theory — hypotheses that can be confirmed empirically? In the seven years of field-testing Anisa two kinds of hypotheses have been generated. First, hypotheses based upon the traditional (Campbell and Stanley, 1966) research designs using control group, norm-referenced objective measures, and statistical procedures (e.g., t-tests, analysis of variance, etc.) were extensively used. These hypotheses concerned relationships between educational experiences and effects on students and staff. A six-year longitudinal study of achievement outcomes, for example, has been conducted using a control group design. The results have been positive (see Chapter VII). In general, all of the "hard methodologies" for hypothesis testing consistent with the mechanistic paradigm can be used. However, in evaluating a good scientific theory, it should be able to generate a second kind, that is, a new and testable hypothesis. Some new hypotheses were tested on evaluating the effects of the process-curriculum (e.g., classification, seriation, etc.), using newly developed instrumentation (Hambleton, R. et al., 1974). The traditional control group design, however, was still used attempting to establish a cause and effect relationship between Anisa teaching practices and process outcomes.

Since Anisa is concerned with change, emerging hierarchic structures, reciprocal and final causes, etc., relatively few have been systematically tested in the field. The theory, nevertheless, is able to generate numerous testable hypotheses. The major practical limitations are related to funding for both the design of the experimentation and development of new instrumentation. The Anisa Model has identified new research methods (see Chapter VII) that are available for empirical hypothesis testing.

It is notable that the strengths and weaknesses of Anisa as a theory can be evaluated separately from the characteristic of implementing (hypothesis testing) Anisa in the field. At a very pragmatic level Anisa, as an adequate theory of education, should serve as a guide for the following: (1) to focus the energies of teachers and administration on a systematic effort to help children learn, (2) to provide the basis for deciding how to organize optimal learning environments and for deciding what activities to include in the curriculum, and (3) to provide criteria for evaluating program effectiveness (Bissell et al., 1975). An inadequate theory is one that fails to give the teachers and adminstrators such a framework for planning, structuring, and evaluating. With respect to the Anisa Model, Dr. Bissell (1975) states, "...there is no question that Anisa offers unique attributes as an educational approach. Its attempt to deal with organizational and administrative aspects of schools as well as aspects of classroom methods on curriculum is unique. Few other approaches to early education are as broad in scope as is Anisa."

Summary

It was demonstrated how Anisa fulfills each of the three basic steps of the scientific process (i.e., observation, model building, and hypothesis testing) qualifying as a scientific theory of education. The observation step clearly identified the unit(s) of study. Initially starting with man as the basic unit of study, a more fundamental unit — change — was identified. In model building, Anisa demonstrates a clear and explicit articulation of its underlying assumption — the first principle of process as the translation of potentiality into actuality. From this basic assumption, five comprehensive and coherent bodies of theory were developed: (1) theory of development,

(2) theory of curriculum, (3) theory of pedogogy, (4) theory of administration, and (5) theory of evaluation. A precise data language was developed. Every newly developed theoretical concept was tested against relevant empirical studies helping to establish a firm empirical footing. Beginning with such an empirical base, Anisa is able to generate testable hypotheses using the legitimate mechanistic research designs. Using these criteria, therefore, the Anisa Model qualifies as an empirically based scientific theory.

Chapters II and III illustrated the growth of knowledge using the Kuhnian paradigm perspective. This chapter demonstrated Anisa as a disciplinary matrix, i.e., a scientific theory. The theory, however, also represents an example of "extraordinary science" for it deals with the anomalies of mechanistic science creating a paradigm shift. As a new scientific paradigm for education, it is entering the "normal science" stage. The following chapters address the conceptual, instrumental and methodological problems of the "normal science" stage of paradigm development.

C H A P T E R V

IMPLICATIONS FOR A THEORY OF EVALUATION: CONCEPTUAL PROBLEMS

Since the Kuhnian perspective was used to establish Anisa as a new paradigm, this same framework will be used to develop its implications for the growth of Anisa. It was illustrated how Anisa dealt with the anomalies leading to the theoretical crisis of mechanistic science resulting in a paradigm shift. Anisa, therefore, based on its presuppositions and exemplar of learning, now is seen to be in the "normal science" phase of growth.

For those who are already working within the organismic view and those in education who will toil within the Anisa paradigm, the insights that Kuhn offers for the growth of knowledge should help clarify the emerging problems that need to be solved. It is notable, again, that paradigms become accepted because they solve some problems that a group believes to be important. The hope of success in the beginnings of a paradigm is the discovery of selected and still incomplete puzzles. The actualization of that hope occurs in the normal science phase which deals essentially with three interrelated issues: (1) determining what are the significant facts; (2) matching fact (nature) with theory; and (3) further articulation of theory. We are moving into the mopping-up phase of solving legitimate problems and fitting them into the conceptual boxes supplied by the Anisa paradigm. Within these issues, the following problems will be the primary focus of Chapters V, VI and VII, respectively: conceptual; instrumental; and methodological.

Normal Science: Conceptual Problems

The conceptual problems are related to the first issue of determining what are the significant facts of the Anisa paradigm. The pathways of scientific thought are determined by the presuppositions of the scientific practitioner. It is highly desirable for the scientist to know consciously and be able to state explicitly his presuppositions.

While the Anisa first principles were presented above, a further elaboration will be made to clarify and offer some possible solutions to identified conceptual problems. Since the Anisa framework rests on the empirical base of its theory of evaluation (see Figure 3), the first order of evaluation should be concerned with evaluating the first principles underlying the nature of man.

Anisa was highly influenced by the organismic philosophy of Whitehead, who viewed the universe as being characterized by change. Change implies process which presupposes potentiality. The actualization of potentiality is the basic principle of the organismic approach. This approach can also accommodate the mechanistic by transcending its limitations with its concern for wholeness, unity, and organism which results in a comprehensive and coherent view of man and the nature of physical reality. Man, as an active organism, is an integral part of a hierarchically structured universe. Hierarchy is defined as sets of things graded in levels with each level implying the appearance of new qualities which require new criteria of explanation.

Whitehead begins with human existence as the apex of known hierarchic organization and works in the reverse direction to the happenings in atoms. This scheme enabled Whitehead to explain more adequately the emergence of consciousness and purpose. Whitehead (1958) states:

> Mankind has gradually developed from the lowliest forms of life, and it must therefore be explained in terms applicable to all such forms. But why construe the later forms by analogy to the earlier forms? Why not reverse the process? It would seem to be more sensible, more truly empirical, to allow each living species to make its own contribution to the demonstration of factors inherent in living things (p. 15).

Central to these concepts is Whitehead's "subjectivistic principle" which maintains that everything — atoms to man — is, in part, determined by its own internal state. It acknowledges that efficient environmental causes influence this state but do not fully determine the behavior. At the human level, with the addition of consciousness and the capacity for symbolization, this principle is translated into subjective aim or purpose. This capacity gives man greater ability to project an ideal and plan for the future giving him a greater degree of freedom in determining not only his own ontological but phylogenetic future.

An excellent summary of the development of organismic principles in scientific thought is presented by McCullough (1977). More recently, Gregory Bateson (1979), another significant worker within the organismic perspective, in his Mind and Nature: A Necessary Unity, relates some of the conceptual issues which can be applied to the Anisa first principles. If Anisa is to fulfill its promise of a new paradigm, its theory of evaluation should clarify what the significant facts are to be studied. Given the above first principles, the significant facts are related to man — consciousness, change, hierarchic organization, etc. At the highest level, the object of study is to understand man himself, a large portion of which is mind.

Anisa deals with these problems in a very general way. Bateson (1979) further clarifies some of the paradigm puzzles. For example, he establishes basic criteria of mind such that if any aggregate of phenomena, any system, satisfies these criteria, the aggregate is a "mind." He believes that such a structuring of epistemology, evolution, and epigenesis is possible and can resolve the mind-body problem along these lines. He argues that phenomena called "thought", "evolution", "ecology", "life", and "learning" occur in systems that fulfill the following criteria:

1. A mind is an aggregate of interacting parts or components.
2. The interaction between parts of mind is triggered by difference, and difference is a nonsubstantial phenomenon not located in space or time; difference is related to negentropy and entropy rather than to energy.
3. Mental process requires collateral energy.
4. Mental process requires circular (or more complex) chains of determination.
5. In mental process, the effects of difference are to be regarded as transformations (i.e., coded versions) of events which preceded them. The rules of such transformations must be comparatively stable (i.e., more stable than the content) but are themselves subject to transformation.
6. The description and classification of these processes of transformation disclose a hierarchy of logical types immanent in the phenomena (p. 92).

Several of these will be presented in greater detail to show how these within-paradigm differences, which can be reconciled, deal with basic conceptual problems. First, the problem of object-subject will be presented, i.e., how the theory can, in essence, explain itself.

Second, but closely related, are problems concerning hierarchic structures. The "logical types" developed by Russell and Whitehead in their Principia Mathematica offer a possible solution to this problem resolving some of the concerns raised by Kurt Gödel (1979). Third, problems of change will be discussed. For Anisa, change is the constant, with learning as a key factor in the dynamic balance between stability and novelty. Bateson introduces stochastic processes for both individual and evolutionary changes, with the latter effectively dealing with the Weissmannian barrier between somatic and genetic change. Fourth, the problem of continuity vs. discontinuity and its relationship to time will be considered.

Problems of self-reference: object-subject. With respect to the first two problems, Bateson draws upon Russell and Whitehead whose goal in the Principia Mathematica was to derive all of mathematics from logic without contradictions. This required eliminating "strange loops" from logic, set theory, and number theory. Initially, it appeared that Russell and Whitehead outlined a system that was both consistent (contradiction-free) and complete, i.e., every true statement of number theory could be derived within their framework. Their system for dealing with "strange loops" in logic involved sets. For example, most sets are not members of themselves; thus, the set of horses is not a horse (a set is not an animal). These sets are "run-of-the-mill"; however, there are "self-swallowing" sets that contain themselves as members, or the set of all sets. Every set is either run-of-the-mill or self-swallowing, and no set can be both. Carried further, it is possible to create R: the set of all run-of-the-mill sets. R, therefore, might appear as run-of-the-mill creation; but, you must revise your opinions when you ask "Is R itself a run-of-the-mill set or a self-swallowing set?" The answer is neither, for either choice leads to Russell's famous paradox (Hofstadter, 1979).

Russell and Whitehead attempted to save logic from paradox. The common element in paradoxes is "self-reference" or "strange loopiness." Another example is the paradox of Epimenides. Epimenides was a Cretan who said, "Cretans always lie". Contradiction is created when we ask, "Could Epimenides be telling the truth?" The answer is: "If yes, then no," and "If no, then yes". Presented to a computer, the answer is Yes...No... to infinity.

The Epimenides paradox is a one-step strange loop. It violates the dichotomy of true and false, because if you think it is true, then it quickly backfires making you think it is false. Once you decide it is false, a similar backfiring occurs — a strange loop.

Russell and Whitehead created the theory of types to handle paradox. Hofstadter (1979) summarizes their system:

> A set of the lowest "type" could contain only "objects", or sets of the lowest type. A set of the next type up could only contain objects, or sets of the lowest type. In general, a set of a given type could only contain sets of lower type, or objects. Every set would belong to a specific type. Clearly, no set could contain itself because it would have to belong to a type higher than its own type (p.21).

This theory of logical types rids set theory of its paradoxes — strange loops. This was accomplished by introducing a hierarchy which prevented looping back inside language. In a hierarchy, therefore, we may go from "class", to "class of classes", to "classes of classes", etc. Bateson uses the theory of "logical types" to deal with issues of hierarchic organization which are central to living systems, particularly mind. Bateson demonstrates a number of analogues in the real world to Russell's abstract step from class to class of classes. There is speculation as to whether Whitehead and Russell knew when they were working on the Principia that their interest was vital and cast light on the life of human beings and the whole of biology.

As noted above, the goals of mechanistic science are objectivity, control, prediction, which are then conceptualized in quantitative terms. The role of mathematics (logic) is equally central to organismic science; therefore, it is appropriate to consider some of its limitations. Bateson (1979: 58) demonstrates how logic is a poor model of cause and effect. The if...then... of logic in a syllogism is very different from the if...then... of cause and effect. Computers can simulate all the processes of logic, but they cannot simulate all the sequences of cause and effect. Thus, when sequences of cause and effect become circular or more complex, the mapping of those sequences onto logic becomes self-contradictory. The if...then... of logic is timeless and generates paradoxes; the if...then... of causality requires time. This concept of time will be further elaborated as a key variable in change processes.

While Bateson applies Whitehead's "logical types" as the analogue for hierarchic structures in living systems, there are major questions in the axiomatic system presented in the Principia Mathematica.

Kurt Gödel in his 1931 paper revealed that there were "holes" in Russell and Whitehead's axiomatic system and that no system could produce all number-theoretical truths. Gödel's Incompleteness Theorem brought the Epimenides paradox into the Principia which was to be free of inconsistency or "strange loops." It is notable that Russell and Whitehead developed "logical types" to deal with paradox, and it is this system that Bateson applies to hierarchic living structures. While Gödel's strange loop did not destroy the Principia, his limitative theorem made Russell and Whitehead's work less interesting to mathematicians.

Gödel's work is not only of interest in showing the limitation of formal logic — or any quantitative system used in science, but focuses attention on problems of understanding our own minds — consciousness. Since this is one of the major concerns for Anisa, these limitations will be explored. Hofstadter (1979) deals with this in great detail. Gödel's theorem shows that there are fundamental limitations to formal systems suggesting that ultimately we cannot understand our own minds. This raises semantic questions of what we mean by "understanding" our own minds. For instance, the self-mirroring involving being able to monitor your own brain in detail is absurd; however, the goal of knowing oneself in some profound way may be feasible. There is, nevertheless, probably some Gödelian strange loop which limits the depth of understanding. As Hofstadter states, "Just as we cannot see our faces with our own eyes, is it not reasonable to expect that we cannot mirror our complete mental structures in the symbols which carry them out?"

The essential point is that all limitative theorems of metamathematics, e.g., Gödel's Incompleteness Theorem, Church's Undecidability Theorem, Turing's Halting Theorem, and Tarski's Truth Theorem, suggest that once the ability to represent your own structure reaches a certain point, that is, an end which assures that you cannot represent yourself totally. As noted above, it also limits the degree to which science in its Western version of object and subject can use the self-application of science, i.e., science studying itself as an object — Kuhn and Piaget notwithstanding.

While Gödel's Theorem demonstrates fundamental limitations to consistent formal systems in mathematical logic, with self-images, the use of the Gödelian metaphor translated to other disciplines as equally valid would be a big mistake. It may suggest new truths for psychology or Anisa, for example, but there is no evidence that it could be translated without modification. Gödelian's proof does, however, have some implications for understanding consciousness. Hofstadter believes that "strange loops" are the crux of consciousness. The explanation of "emergent" phenomena in our brains — ideas, hopes, images, analogies, free will and consciousness — are based on a strange loop, the interaction between levels in which the top level reaches down towards the bottom level and influences it, while at the same time being itself determined by the bottom level. There is a self-reinforcing "resonance" between different levels; the self comes into being at the moment it has the power to reflect itself.

The explanation of the mind requires "soft" concepts such as levels, mappings, and meanings. Hofstadter observes that we don't need a description of positions and movement of physical particles but descriptions of neural activities to "signals" which relate to "symbols", "subsystems", and "self-symbols." He views this act of translation from low-level physical hardware to high-level psychological software as analogous to the translation of number-theoretical statements into metamathematical statements (logical typing). Hofstadter believes that the level-crossing which takes place at that exact translation point is what creates Gödel's incompleteness and also creates our nearly unanalyzable feeling of self. A Gödel vortex where all levels cross — a vortex of self — is responsible for the tangledness of mental processes. This self-reference may well be the heart of all Artificial Intelligence and can be the focus for attempts to understand how the human mind works — Gödel's work is therefore an important contribution toward that end.

This position is close to one held by Roger Sperry (1977), a neuroscientist, who states:

> In my own hypothetical brain model, conscious awareness does get representation as a very real causal agent and rates an important place in the causal sequence and chain of control in brain events, in which it appears as an active, operational force...To put it very simply, it comes down to the issue of who pushes whom around in the population of causal forces that occupy the cranium. It is a matter, in other words, of straightening out the peck-order hierarchy among intracranial control agents. There exists within the cranium a whole world of diverse causal forces; what is more, there are forces within forces within forces, as in no other cubic half-foot of universe that we know. ...To make a long story short, if one keeps climbing upward in the chain of command within the brain, one finds at the very top those overall organizational forces

> and dynamic properties of the large patterns of cerebral excitation that are correlated with mental states or psychic activity...Near the apex of this command system in the brain...we find ideas. Man over the chimpanzee has ideas and ideals. In the brain model proposed here, the causal potency of an idea, or an ideal, becomes just as real as that of a molecule, a cell, or a nerve impulse. Ideas cause ideas and help evolve new ideas. They interact with each other and with other mental forces in the same brain, in neighboring brains, and thanks to global communication, in far distant, foreign brains. And they also interact with the external surroundings to produce in toto a burstwise advance in evolution that is far beyond anything to hit the evolutionary scene yet, including the emergence of the living cell (p. 242).

Hofstadter's work using Gödel, Escher, and Bach makes a contribution to our understanding of consciousness and hierarchical living systems which are within the organismic paradigm and, therefore, relevant to solving some of the Anisa puzzles. It resolves the breach that supposedly exists between two languages of discourse: the subjective and objective. For example, the "subjective" sensation of redness and the "objective" wavelength of red light. The subjective feeling of redness comes from the vortex of self-perception in the brain; the objective wavelength is how you see things when you step back, outside the system. Although no one is ever able to step back far enough to see the big picture, we need to be aware that it exists.

Hierarchic organization: form and process. The basic facts that the Anisa paradigm must deal with are rooted in its presuppositions on the nature of reality. The central concept is change. Thus we need to understand this process of change from the individual to evolutionary change. Since Anisa assumes that the universe is hierarchically organized with man (mind) at the apex of evolutionary development, the understanding of these basic phenomena are the primary puzzles that the organismic paradigm needs to solve. Bateson converts some of these phenomena into puzzle forms which can be solved. Thus, the phenomena of "life", "evolution", "learning" are defined if they fulfill the defined criteria specified above.

One of the significant puzzles to be solved is concerned with understanding hierarchic organization. As part of a solution to this puzzle, Bateson draws on Russell and Whitehead's *Principia* applying their work on abstract logic or mathematics not to an empty hierarchy of names of names or classes of classes of classes for this empty world is insufficient for the scientist. Bateson maintains that we must deal with an interaction of digital (i.e., naming) and analogic steps; thus, the process of naming is itself nameable which requires an alternation in place of the simple ladder of logical types proposed by the *Principia*. He recombines his two "stochastic systems", which he has divided into "evolution" (genetics) and "mental process" (learning), as two alternating steps. The *Principia* presents a ladder made of steps that are all alike (names of names of names, etc.) while Bateson believes there is an alternation of two species of steps. Thus, to get from the "name" to the "name of name", we go through the process of naming the name; there is a generative process where classes are created before they can be named. This movement from classes to process requires an understanding of the relationship between form and process; the former as an analogue to "tautology" and the latter as an analogue of the aggregate of phenomena to be explained.

It is agreed that the brain contains no material objects other than its own circuits and metabolic energy. Thoughts about dogs and oranges are only "ideas" of dogs and oranges. The process of coding, i.e., the representation that substitutes the idea of dogs or oranges for the things is a big jump in "logical typing"; the name is not the thing named and the idea of dog is not the dog. Thus, the first step from dogs into the coded version places the thinker into an abstract, tautological universe. Bateson believes that the very process of perception is an act of logical typing — all images are a complex of many-leveled coding and mapping.

The dichotomy between form and process which exists in our scientific minds also characterizes the relationship among the phenomena we attempt to analyze. The things-in-themselves (the Ding an sich) are not accessible to direct inquiry but, nevertheless, have relationships among themselves. They also can have no direct experience of each other; a concept of great significance for understanding the living world. The basic presupposition is that "ideas" have a reality. They are what we can know; the "laws" that bind the "ideas" together are as close as we can get to ultimate truth.

Bateson illustrates this process with an example from his work in anthropology with a New Guinea culture. The first step was classification of behaviors in terms of types, e.g., typing of sexes. This then led to questions of processes that generated the differences that led to those interactions between men and women that created the differentiated ethos that was the basis for his typology of persons; thus, he wanted to understand how the behavior of men determined that of women, and vice versa.

His next step was from process to a typology of process. He labeled the processes using the term "schismogenesis" and then classified them. A basic dichotomy was possible indicating that the processes of interaction that lead to the potentiality of promoting schismogenesis could be classified into two genera: the symmetric and the complementary. The symmetric applied to those interactions that could be described as competition, rivalry, mutual emulation, etc. For example, A's action would stimulate B to action of the same kind of feeding back to stimulate A to similar actions... Thus, if A engaged in boasting, this would stimulate B to more boasting, and vice versa.

The complementary interaction sequences, on the other hand, were such that the actions of A and B were different but complementary, i.e., dominance-submission, exhibition-spectatorship, dependence-nurturance, etc. It suggested that these paired relationships were schismogenic with dependency promoting nurturance, and vice versa.

Using this typology, not of persons, but of processes, Bateson experimented with effects generated by these processes, i.e., what happens when symmetrical rivalry (leading to excessive competition) was mixed with complementary dependency-nurturance? The results of the interactions between these processes proved to be mutually negating, i.e., have mutually opposite effects on relationship. Therefore, when complementary (dominance-submission) has gone too far, a little competition relieves the strain; and, when competition goes too far, a little dependency is a comfort. In summary, there is an alternation between classification and the description of the process. There is an alternative ladder from description of persons (typing) which leads back to the study of process by which persons got that way. These processes are then classified into types of processes leading from the typing of process to the study of the interactions between classified processes. This is illustrated in Figure 5.

The point of Bateson's example, therefore, is to illustrate that taking the concept of "logical typing" out of abstract mathematical logic and using it to map real biological events onto hierarchies we encounter in mental and biological systems that hierarchies are not only lists of classes, classes of classes, and classes of classes of classes, but has become a zigzag ladder of form and process. Bateson further suggests that perception and learning follow such a zigzag model. In addition, the relation between somatic and phylogenetic change and the relation between the random and the selected have the same zigzag form. Similar relations obtain between continuity and discontinuity and between number and quantity. Therefore, this zigzag relationship may possibly resolve a large number of puzzles in the fields of ethics, education and evolutionary theory.

Bateson uses another illustration of calibration-feedback as synonymous with form-process. It will be helpful to present several examples of calibration-feedback to clarify the relation between two levels of structure mediated by an intervening description of process

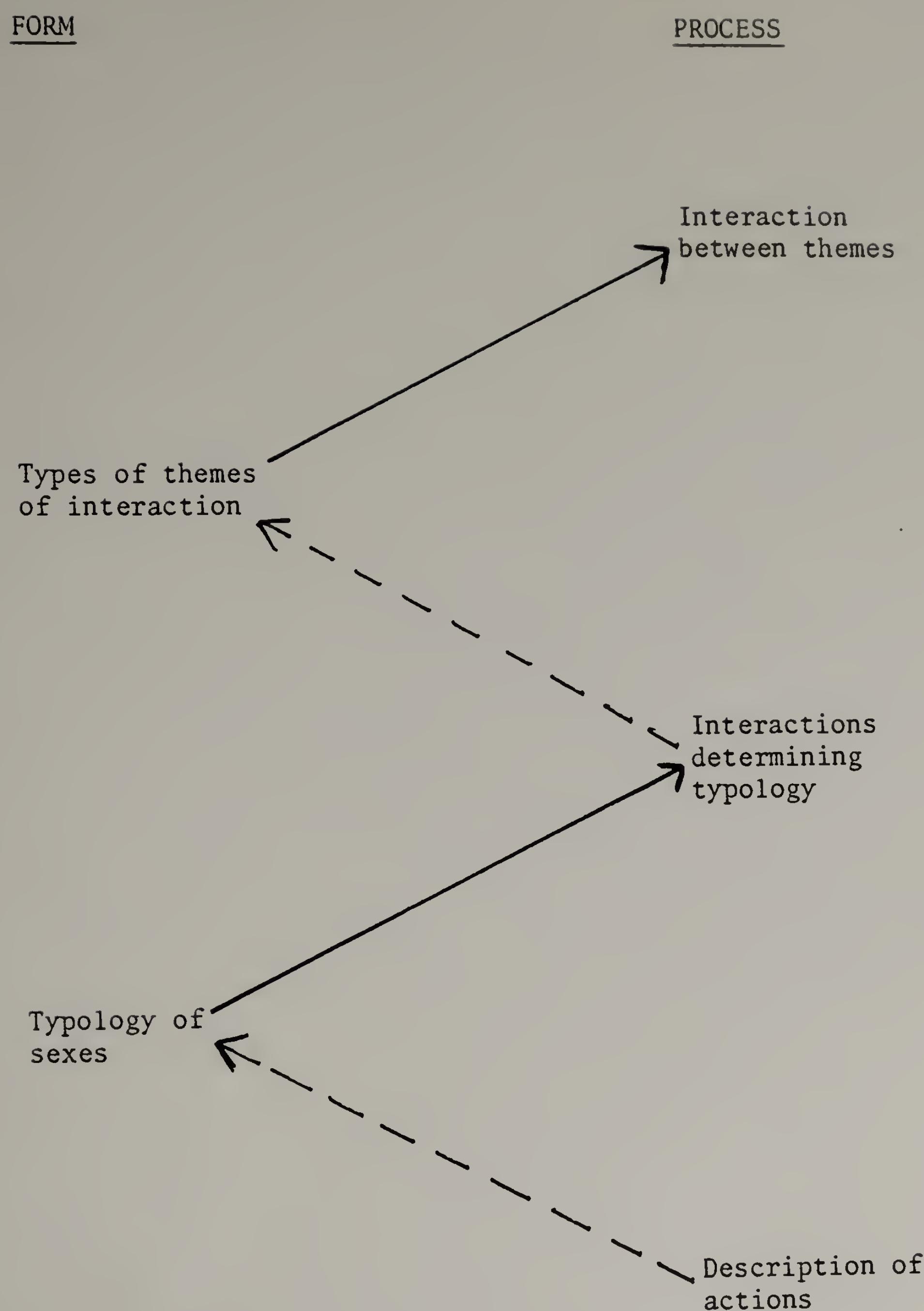


Figure 5. Levels of analysis of a New Guinea culture. (Bateson, 1979)

because this is the analogue in the real world of Russell and Whitehead's abstract step from class to class of classes. The illustrations, therefore, should help to clarify the relationship between higher and lower logical type and its significance for understanding "time."

Bateson uses an example based upon Harst Mittelstaldt's (1960) work suggesting two methods of perfecting an adaptive act. The first involves an act of shooting a bird with a rifle. There is the sighting of the rifle correcting for errors by immediate feedback. The importance is the act of self-correction occurring within the single act of shooting; therefore, the concept of "feedback" is used to characterize this method of perfecting an adaptive act. The second method involves a man shooting a flying bird with a shotgun. Error correction in the single act is limited; improvement requires that correction be performed upon a large class of actions. He must practice over and over again, shooting skeet, etc. which adjusts his nerves and muscles to a point where an optimum performance is automatic. Mittelstaldt refers to this method as "calibration." Thus, self-correction in using a shotgun comes from information based on practice — from a class of completed, past actions. The relation of "calibration" to "feedback" is as a higher logical type is related to a lower. The contrast of logical typing is the contrast between a single instance and a class of instances. "Calibration", therefore, is comparable to "form" and "feedback" to "process."

An example of the hierarchic relation between feedback and calibration is illustrated by the temperature control in a house equipped with a furnace, thermostat, and a human being.

Figure 6 summarizes levels of temperature control.

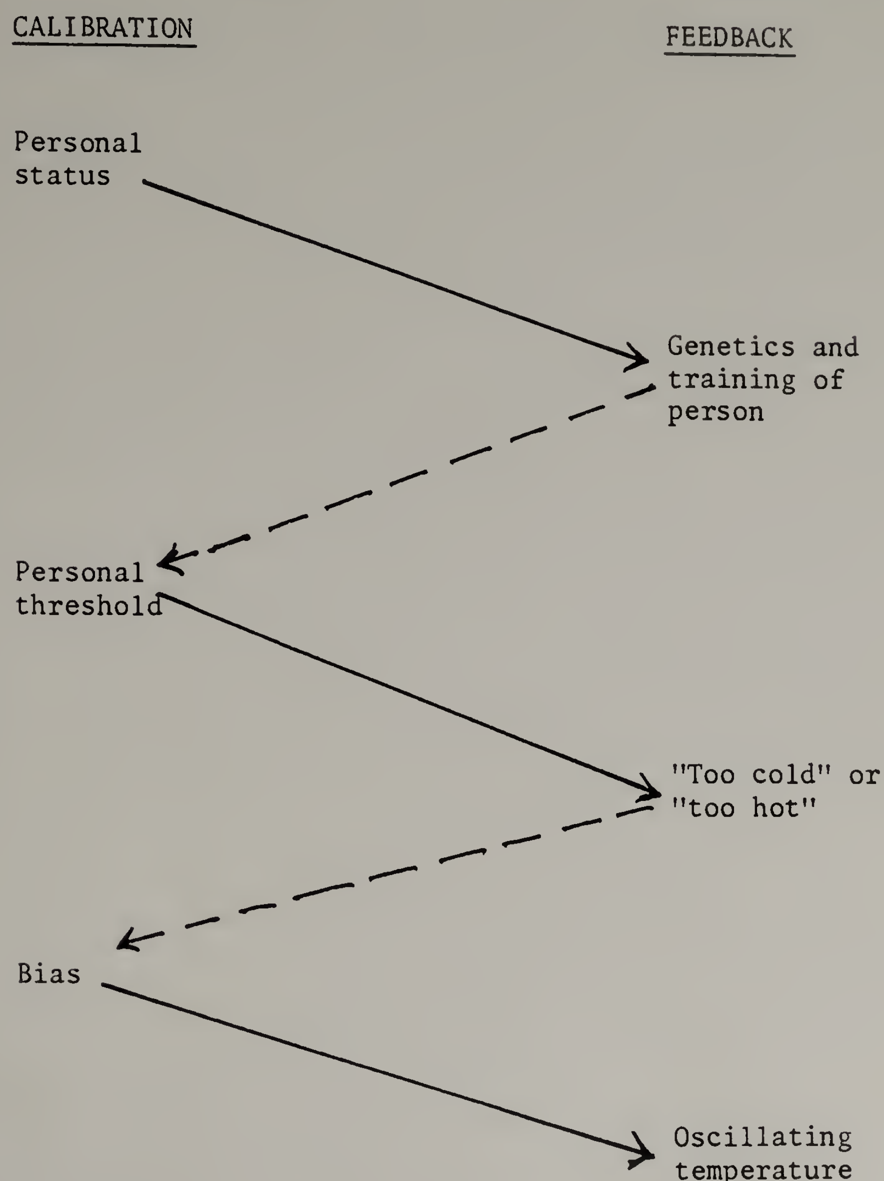


Figure 6. Levels of Control of House Temperature. The arrows mark the direction of control. (Bateson, 1979)

The temperature variation (a process) at the lowest level affects a thermometer that is connected to the system which breaks an electric connection (a calibration) that controls the furnace. This simple, servo circuit will have the temperature of the house oscillate between two set threshold points. This feedback circuit is controlled by a calibration that sets the thermostat to different temperatures (bias). The owner will judge from his experiences the temperature range most suitable to him. This bias (the calibration of the feedback) is also governed by feedback from the sense organs of the owner.

His "bias" or "threshold" is set by a feedback system based on his experiences or wishes. For example, he may become calibrated to become more tolerant of cold as a result of hardship or mere lack of oil supplies. The feedbacks and calibrations alternate, therefore, in a hierarchic sequence. The sphere of relevance increases with each completed alternation. At the lowest level, the furnace was ON or OFF; at the next level of the ladder, an oscillation around a set temperature of the house. At the third level, the sphere of relevance increases to include the owner. Thus, with each zigzag of the ladder, there is a change in logical typing of the information collected by the sense organ at each level.

Bateson provides a more relevant example of a driver of an automobile traveling at 70 miles per hour triggering the radar (sense organ) of a traffic policeman. The "bias" of the policeman is set at a difference greater than 10 miles above speed limit. His "bias" was set by the police chief who acted on orders, i.e., calibration, from the state capitol. The capitol acted self-correctively with the legislator's eyes on their voters. The voters also set a "calibration" within the legislature in favor of either Democratic or Republican policy. The alternating ladder of calibration and feedback moves up to larger spheres of relevance and more abstract information and wider decision.

The significant aspect of this example within the system of police and law enforcement — and in all hierarchies — is the undesirability of having direct contact between levels that are nonconsecutive. It is not desirable for the organization to have a direct line of communication between the driver and the state police chief. This line of communication creates a bad morale problem for the police force. In turn, it is not desirable for the policeman to have direct access to the legislature, which then undermines the authority of the police chief.

To jump down two or more steps in the hierarchy is also unwise. Thus, it is unwise to have the policeman have direct control over the accelerator of the car. The jumping of logical levels in legal and administrative systems is called ex post facto legislation. In genetics, the Weissmannian barrier prevents the direct influence from the somatic state to the genetic structure and, therefore, prevents the disasters that could occur if the hierarchy of organization within the organism were destroyed.

The comparison of "learning" to shoot with a rifle and "learning" to shoot with a shotgun poses some problems for the hierarchy of logical types. While both learnings involve cybernetic circular, causal and feedback sequences, there is an important difference. The man with the rifle has immediate feedback and does not need to change himself as does the man with the shotgun. The whole operation of aiming-and-firing is a single act that must be carried forward to the next firing. The nonverbal, kinesthetic information gained results in a change in himself. The key difference, therefore, is that the rifleman goes around his feedback circuit a number of separate times; the man with a shotgun must accumulate his skill over successive experiences.

The issue that Bateson raises is the relation between calibration and feedback. Is there such an alternation in the world of adaptive action and is it also characteristic of mental processes? Bateson observes that some typologists would prefer to believe that the world is primarily dominated by calibration (normative psychometritions); there are others who see only process or feedback. The resolution suggested by Bateson depends on the concept of "time" as is the resolution of Russell's paradoxes of abstraction by the introduction of time. Bateson (1979) states:

> ...the system of thermostatic control of the temperature of the house and the system of law enforcement are necessarily discontinuous for reasons connected with "time." If any event is to depend upon some characteristic of a multiple sample of some species of event, time must elapse for the accumulation of that sample, and this elapsed time will punctuate the dependent event to produce a discontinuity. But, of course, there would be no such "samples" in a world of purely physical causation. Samples are artifacts of description, creatures of mind, and shapes of mental process.
>
> A world of senses, organization, and communication is not conceivable without discontinuity, without threshold. If sense organs can receive news only of difference, and if neurons either fire or do not fire, then threshold becomes necessarily a feature of how the living and mental world is put together.(p. 202).

A paradigm raises legitimate problems that need to be converted into puzzle form with the likelihood of solution. Bateson accomplishes this by providing a possible solution to a range of problems translated into puzzle form. Of his six criteria of "mind", the most important possible solution to understanding hierarchic organization is his insight of applying Russell and Whitehead's logical typing to real world phenomena of biology and mind. More specifically, it makes an important contribution to Anisa for it helps to clarify a number of conceptual, within paradigm, issues.

There are clear parallels between Bateson's concepts of "calibration" and "feedback" and Jordan's operationalized concept of "management" and "leadership" or, in other terms, the dynamic balance between "order" and "novelty." The contribution that Bateson makes is to show how this zigzag process operates by introducing "time" to handle the discontinuity as change leads to a higher hierarchic level (logical typing).

Unity of genetics and learning: stochastic systems. Learning, as defined by Anisa, is the key to the release of psychological potentialities, allowing man to take charge of his own as well as direct his phylogenetic destiny. Because of the Weissmannian barrier between somatic and genetic change, for example, the role of learning in relationship to evolution raises questions. Bateson appears to have worked through some of the problems by showing how two stochastic systems, working at different levels of logical typing, fit together into a necessary unity. This unity combines the stochastic system within the individual, which is called "learning"; the other is in heredity and in populations and is called "evolution."

Bateson (1979) defines the meaning of stochastic. (Greek: stachazein — to shoot with a bow at a target; that is, to scatter events in a partially random manner, some of which achieve a preferred outcome.) "If a sequence of events combines a random component with a selective process so that only certain outcomes of the random are allowed to endure, that sequence is said to be stochastic."

No system can produce anything new unless the system contains some source of the random; this is true both for computers and living systems. Thus, creative systems are divergent; events that are predictable are convergent. Divergence is a potential source of either disorder or innovation. Our limited biosphere is determined by two interlocking stochastic processes which are changing. The rate of change, however, is limited by three factors: (a) the Weissmannian barrier between somatic and genetic change ensures that the somatic adjustments shall not rashly become irreversible; (b) in every generation, sexual reproduction provides a guarantee that the DNA blueprint of the new shall not conflict outrageously with the blueprint of the old, a form of natural selection of the level of DNA regardless of what the deviant new blueprint may mean to the phenotype; and (c) epigenesis operates as a convergent and conservative system — the developing embryo is, within itself, a context of selection favoring conservation.

There are two stochastic systems, according to Bateson, that combine to determine the larger total system we call evolution. Each subsystem has two components — a random component and a process of selection working on the products of the random component. For the first stochastic system, the random component is internal: genetic change through mutation or reshuffling of genes in population. It is assumed that mutation is nonresponsive to environmental demand. The eggs are generally protected from the external environmental dangers.

The second stochastic system is concerned with external adaptation; the random component is related to the interaction of the phenotype with the environment. A particular acquired characteristic produced in response to a given environmental change may be predictable. For example, if a food supply is limited, metabolizing the organism's own fat will result with loss of weight. Prediction of particular change is also possible within the environment; thus, change in climate may reduce the biomass for some species. Bateson emphasizes that together there is an unpredictability; neither organism nor environment contains information about what the other will do next. There is, nevertheless, a selective component present which is somatic change evolved by habit that is adaptive. In essence, the combination of phenotype and environment constitute the random component of the stochastic system that proposes change; the genotype disposes by allowing some changes and precluding others. The key concept is that genetics sets the limits of somatic change.

The genome of the individual contains the potentials for change, providing storage for alternative pathways of adaptation. Many alternative pathways are not used and remain invisible in any given organism. The gene pool of the population is usually heterogeneous, providing a bank of alternative genetic pathways that the population can take under pressure of selection. Dobzhansky documented that the unit of evolution is the population. It is the population that responds to environmental pressures. The individual has the capacity for adaptive somatic change, but the population, by selective mortality, undergoes change which is transmitted to the next generations. The potentiality for somatic change is the object of selection; environmental selection acts on populations.

How do each of these two stochastic systems contribute to the total process of evolution? First, in both the selective component gives direction to the changes that will be ultimately incorporated. There is a time frame that differs between the two stochastic processes. The first stage of genetic change is conservative since the new DNA in random genetic change is in existence from fertilization but may not effect external adaptation until later. This internal selection first evident in cytological processes, e.g., dance of the chromosomes, mitochondria, etc., shows very deep formal patterns shared by all cellular organisms. With respect to the theory of recapitulation, therefore, the expectation is that embryos will resemble in formal pattern the embryos of ancestral forms more closely than formal patterns of adults will resemble those of ancestral adults. Bateson observes that this differs from Haeckel's and Herbert Spencer's view that embryology has to follow the pathway of phylogeny. Bateson's concept holds that deviation from the beginning of the pathway is less probable than from later states.

The machinery of change, therefore, is not permissive nor creative but shows a determination where changes that do occur are members of a class of changes for that particular machinery. Thus, the system of random genetic change is filtered by the selective process of internal viability giving to phylogeny a pervasive homology. This process within the genetic subsystem could be considered as analogous to Jordan's concept of differentiation and integration operative at this biological level.

In considering the other stochastic system, Bateson arrives at a different view. He notes that no learning nor somatic change can directly affect DNA, but that somatic changes are, nevertheless, usually adaptive. The individual may initially pant at high altitude but the individual can learn to adjust his physiological system to permit him to stay at the high altitude. The adjustment may immediately reduce the stress through acclimation but may be nonintegrative in the long run. Somatic adjustment, therefore, creates a context for genetic change, but whether genetic change follows remains a question.

Bateson speculates on the spectrum of what possibilities somatic change can achieve with this stochastic component of evolution. The most significant aspect, he observes, is related to all somatic changes as quantitative or "analogic." In man, the nervous system and DNA are largely "digital" but his physiology is analogic. Digital is simply defined as a discontinuity between one signal and an alternative; thus, for example, "yes" and "no" are digital signals. An analogic signal is present when a quantity in a signal is used to represent a continuously variable quantity. The random genetic changes of the first stochastic process are essentially digital; the somatic changes are solely analogic or quantitative. Since quantity does not determine pattern, the difference is significant. At a deep epistemological level, Bateson notes, the contrast between digital and analogic is sharp; this discontinuity is a fundamental barrier between the somatic and the genetic.

Bateson then shows how the double stochastic system of biological evolution is also characteristic of thought. Instead of a Platonic prime mover hiding in the machinery of evolutionary processes, Bateson holds that "thought" is also stochastic. Creative thought must always contain a random component — the trial and error of mental progress. The new can only be achieved by trying pathways randomly presented, some of which when tried are selected and survive.

Since thought is stochastic, there should be a binary division of thought processes that will also be stochastic in both halves with the random component of one half, digital and the random component of the other, analogic. Bateson considers the first as the selection processes that govern the outcome. He illustrates the two principal modes of testing thoughts; the first simply being a test of coherence. Does the new idea make sense in terms of what is already believed? The parallel of this process in the brain is close to the stochastic process of random genetic change wherein an internal selection process works for conformity between the new and old. As discussed above, the contrast between epigenesis and creative evolution, in epigenesis all new information is kept out and serves as a critical filter requiring definite standards of conformity. Bateson maintains that in the process of thought, there is a similar filter requiring definite standards of conformity resembling logic — the building up of tautology to create theorems. Rigor for thought is the analogue of internal coherence in evolution. The stochastic system of thought (learning), therefore, resembles that component of evolution in which random genetic changes are selected by epigenesis.

The other process of thought involves the brain and the environment. This is analogous to the process of evolution concerned with adaptation — somatic changes and environment. In learning, as in somatic change, there are limits and facilitations that select what can be learned. Some are internal and others external to the organism. What can be learned at any given time is related to what has been previously learned. There is also a learning to learn with some ultimate genetic limitation to what can be immediately changed in response to environmental demands.

Bateson puts the two stochastic processes together by showing the formal relationship that exists between the two. The primary relationship is shown by the contrast between the digital and the analogic or between the "name" and the "process" that is named. He observes:

> But naming is itself a process and one that occurs not only in our analyses but profoundly and significantly within the systems we attempt to analyze. Whatever the coding and mechanical relation between DNA and the phenotype, DNA is

still in some way a body of injunctions demanding — and in this sense, naming — the relations which shall become apparent in the phenotype (p. 184).

By introducing naming as a phenomena instrumental in the organization of what we study, hierarchies of logical typing become necessary. Russell and Whitehead's abstract logic becomes useful but their empty hierarchy of names or classes is now filled, coping with the interaction of digital (naming) and analogic steps. As noted above, the process of naming is nameable which permits an alternation for the simple ladder of logical types developed in the Principia.

Bateson recombines the two stochastic systems of both evolution and thought process by seeing the two as alternating. It differs from Russell and Whitehead's ladder made of steps that are all alike; it becomes an alternation of the two species of steps. To get from the name to the name of the name, one goes through the process of naming the name. There is a generative process, therefore, wherein the classes are created before they are named.

Bateson's concept is consistent with the organismic paradigm. Therefore, differences that exist are reconcilable: he converts the fact of change into a puzzle form that has the possibility of being solved. The solution, which integrates change at both the individual and evolutionary levels, involves stochastic processes. The additional significance of this solution is that it appears to solve the problem of hierarchic organization required by the organismic paradigm. The key to this possible resolution is the application of Russell and Whitehead's logical typing. Anisa is concerned with change through the release of biological and psychological potentiality into actuality at an optimum rate. Bateson's stochastic processes at the genetic (biological) and thought (psychological) levels integrate these two levels as well as providing a zigzag process between form and process (calibration-feedback) to account for hierarchic organization.

Reciprocal causation, emergent phenomena, discontinuity, and time. These issues were discussed in Chapter III by contrasting the differences between the mechanistic and organismic explanations of these phenomena. Again, as noted in Chapter III, there may be differences among a family of theories within a paradigm but these differences are reconcilable. While a paradigm raises legitimate problems that can be converted into puzzle form, the puzzle solution is a within-paradigm issue. Thus, different theorists working within the organismic perspective are still grappling with these problems and converting them into puzzle form. At this early stage of paradigm development, there is no consensus on the rules and procedures for puzzle solution.

Jordan deals with causation by maintaining that both efficient and final causes must be present to provide the necessary and sufficient conditions for understanding development. Reciprocal causation — a circular, causal, and feedback process — is also operative rather than a simple linear, unidirectional causation. The central problem of Greek philosophy — the problem of purpose, teleology — came within the possibility of solution with the development of cybernetics and systems theory where self-corrective circuits provided a model of adaptive actions for organisms. This issue continues as a problem within the organismic paradigm, i.e., is final cause necessary or can the cybernetic circular causation account for the phenomena.

The problems of reciprocal causation, emergent phenomena, discontinuity, and time will be discussed with heavy reliance on Bateson's latest synthesis. The cybernetic concept of circular, causal, feedback, and self-correcting systems is a relatively simple idea. Although the concept was recognized as early as James Watts' invention of the governor for the steam engine in the eighteenth century, Clark Maxwell's mathematical analysis of the governor of a steam engine (1868) and Bernard's homeostasis, the major breakthrough came with Norbert Wiener, et al. (1943) following World War II. The shift in assumption from the Second Law of Thermodynamics (entropy) to negative entropy gave rise to information, communication, and general systems theories leading to what has been referred to as the "second industrial revolution." Application of these concepts at the physical hardware level has been most productive.

Bateson points out several problems that were encountered by the early inventors in attempting to understand self-correcting circuits. In designing the governor for the early steam engine, for example, there was no theoretical base for predicting how it would run. (Would it go into runaway, exponentially maximizing speed until breakdown or slow down and stop?) Clark Maxwell worked out formal mathematical equations dealing with relations between variables at each step around the circuit but these did not predict the outcome. Maxwell discovered that the engineers had failed to take into account time. Every system has relations to time, and these time-constants are determined by the whole. The constants are not determined by equations of relationships between successive parts but are emergent properties of the system.

To illustrate, Bateson uses the example of the engine running smoothly and then encountering a hill. There are immediate changes; the velocity of the flywheel falls off, the governor spins slower, and more fuel is injected in the cylinder resulting in increased speed. The significance is that the whole process occurs in time. In attempting to describe the events as though one were inside the circuit, it would be described as a change in A determines a change in B, etc. In a description of the event, however, there is a change in syntax. The description now compares change with change, using the result of that comparison to account for the next step. There is a change in what is being described. It is analogous to the difference between the language a physicist would use in describing how one variable acts upon another and talking about the increases or decreases of the circuit as a whole in another language.

This change in discourse reflects what Bateson refers to as a change in logical typing. The questions the engineers posed to Clark Maxwell were about the circuit as a whole and they expected the answers to be in terms of relations between the individual variables. This is quite analogous to the questions educational researchers raise under the mechanistic paradigm and the kind of answer they consider acceptable. What is needed is an answer in terms of the time-constants of the total circuit. This is the bridge between the two levels of discourse; the variables at one level of discourse disappear at the next higher or lower level.

Another example is the word switch or relay where what goes through is energized from a source that is different from the energy source which operates the switch. Thus, the switch exists only at moments of its change which has a special relation to time. Switch is more closely related to the concept of "change" than an "object." Bateson (1979) states:

> The truth of the matter is that every circuit of causation in the whole of biology, in our physiology, in our thinking, our neural processes, our homeostasis, and in the ecological and cultural systems of which we are parts — every such circuit conceals or proposes those paradoxes and confusions that accompany errors and distortions in logical typing (p. 109).

However, with respect to systems involving circular causation, it is possible for systems with positive gain to go into a runaway creating escalating or vicious circles. In Bateson's example of symmetrical interchanges, as presented above, if on a psychological level person A exhibits competitive behavior it makes it more likely that B will exhibit the same behavior, leading to progressive escalation or a runaway. The positive gain at each interchange coupled with adequate metabolic energy can destroy the system in greed, rage, etc. It is notable that it takes relatively little energy for a person to destroy others or the integration of a system. Some runaway systems, however, contain negative links for their own correction; for example, a population explosion might self-correct in the form of epidemics, war, or planned social programs.

There is no systematic knowledge of the dynamics of these processes although ecology as a science appears to be a beginning. Bateson observes that neither random genetic change coupled with natural selection nor trial and error in thought coupled with selective reinforcement will necessarily work for the good of either the species or the individual. Also, inventions or stratagems that are rewarding for the individual may not necessarily have survival value for the group. Equally true, policies that the group might prefer may not necessarily have survival value for individuals.

In explicating the above, Bateson suggests a number of patterns that lead to disasters. The following are examples: (1) a species is so well adapted that by overgrazing it will destroy its ecological niche; (2) what appears desirable in the short term is a disaster over the long term; (3) a group acts as if it is no longer partially dependent on neighboring groups; and (4) a group becomes addicted and tries to hold constant the same rate of change (e.g., armaments races are similar to individual drug addiction). The essence of these disasters is found to contain an error in logical typing. Immediate gain at one logical level is reversed and becomes a disaster in a larger context. Donald T. Campbell's (1975) illustration of the selfish-altruism continuum wherein the selfish needs of the individual spell disaster in the long range for the social group is a good example. E. O. Wilson (1975) cites numerous examples from studies of ants, termites, and bees where the selfless altruistic acts of some result in disaster for the individual organism but have survival value for the colony or hive.

It is notable to point out the contrast between the organismic and mechanistic perspectives in dealing with the phenomena (facts) of change, causation, hierarchic organization (wholes), emergent phenomena, continuity, and time. The organismic paradigm subsumes efficient causation but handles phenomena involving reciprocal causes. While the mechanistic paradigm precludes the possibility that the universal machine has emergent qualities of novelty, these phenomena are primary concerns for understanding organismic processes. Clark Maxwell's experience with designing the governor of a steam engine illustrates the difference between the mechanistic reductionist position and the organismic position of the whole being more than the sum of the parts. The hierarchic organization takes into account non-linear circular or reciprocal causation and not merely the unidirectional linear causation which occurs within an absolute time concept. Organismic structures are hierarchically organized based upon emergent qualities that require time and a discontinuity between levels, i.e., higher levels are qualitatively different from the lower and the new whole cannot be understood by the interaction of the individual parts alone.

These contrasts with the mechanistic paradigm clearly represent a different world view with different presuppositions concerning the basic facts of how the universe operates. There are differences, however, between some organismic theoretical concepts presented by Bateson and Jordan. It is notable, again, that such differences pose a higher probability of being reconciled because they are within-paradigm differences than the futile attempts at reconciling paradigm differences. While it is beyond the scope of this study to reconcile these differences, some will be presented to help clarify the problems and convert them into puzzle form which may result in a solution by others.

It will be desirable to contrast the two approaches to change, showing areas of divergence and convergence. Jordan's first principle deals with the universal constant of change. Since change presupposes potentiality, the primary concern is how potentiality is actualized. Process is the means toward that end which is determined by the quality of interaction with the several environments. Since we have the active organism in contrast to the mechanistic reactive organism, subjective aim and final cause are inherent givens. To the degree that man is freed from efficient cause (instinct), he is able, through learning, to take greater charge of determining his own ontological as well as phylogenetic destiny. Since learning (the conscious ability to differentiate, integrate, and generalize experience) is the key factor, Anisa would need to account for changes in the genetic (DNA) biological processes. While differentiation and integration do occur at the DNA level, the more precise understanding of how is yet to be developed. The Weismannian barrier, for example, poses a problem.

With respect to direction of change, Anisa holds to the view that there is purpose or final cause. Translated into other terms, it is closely analogous to the concept of negative entropy (the universe is an open system with process that tends toward organized complexity).

Negative entropy also presupposes circular, causal, and self-correcting feedback processes. It would appear that Bateson works through some of these problems of change in ways most congenial to Anisa but extending their scope. For example, Bateson unifies epigenesis (learning) and evolution (genetics) by showing, at the deeper level, how they are related to the twin components of the second law of thermodynamics. The random workings of probability always eat up order or pattern (negative entropy); to create a new pattern, a large number of uncommitted random alternatives (entropy) is necessary. The combining of the two stochastic systems of evolution and mental thought (which follow an alternation of two species of steps — logical typing) is briefly how Bateson deals with change. These stochastic processes also deal with hierarchic organization, emergent phenomena, discontinuity, and time. It is patently clear how this view of the universe differs from the mechanistic with its linearity, objectivity, control, prediction, and quantification. The parallel with Anisa regarding man's being largely freed from efficient causes, able to make conscious choices in determining his own future, is found in the stochastic processes where selection is made from the random.

An oversimplified interpretation of Anisa's concept of final cause could lead to an over-optimistic view of man taking charge of the direction of evolution toward some ultimate goal of perfection. Bateson cautions — and it is most important for a theory of evaluation — man is capable of making choices that could lead to a runaway or escalating vicious circles that could be disastrous for the system. In addition, some choices may have short-term advantage for the individual but long-term disaster for the group viewed at a different level of logical typing. Survival, therefore, is not guaranteed. If this is how nature works, a paradigm theory of evaluation should map these processes — on-going, short, and long-term — with data from various hierarchic levels within a system and related interdependent systems. In fact, to increase the probability and quality of survival, great effort should be devoted to developing the most systematic and sophisticated theory of evaluation for making the best choices (decisions) for the individual and group, both for short-term and long-term planning and decision-making.

The present focus has been on conceptual issues; these were primarily centered on the Anisa first principles. Concern with the presuppositions of a new paradigm is the first order of business for such presuppositions are the fundamental postulation of how nature works. For Newton it was matter in motion from which followed his terrestrial and celestial laws of mechanics. From the first principles of Anisa, the theories of development, pedagogy, curriculum, administration, and evaluation were deduced. It is beyond the scope of this study to deal exhaustively with many of the specific issues related to each of the respective theories. Dealing with the fundamental issues should, through a deductive process, lead to a clarification of many problems and further articulation of theory.

Bateson, for example, deals with the fundamental issue of change within an organismic paradigm as a combination of two stochastic processes operating at the levels of evolution and thought. While Watson and Crick saw a double helix organization in DNA, Bateson sees a zigzag alternating process of form and process operating at different levels of logical typing that explain how hierarchic organismic structures emerge. If this organismic view is isomorphic with how nature works, it contributes further clarity to Anisa, particularly the concepts of hierarchic organization based on logical typing. The direct application to Anisa relies on the process of learning which could be modified to incorporate Bateson's thinking. Differentiation would be considered as one level of logical typing; integration taking place at a higher level; and generalization emerging at still a higher organizational level. Inherent in this process are the factors of discontinuity related to time which account for the emergence of a new hierarchically organized whole that is more than the sum of the parts. Having arrived at this level of generalization — Anisa refers to this as a sensitive period — when the random and selective aspects of the stochastic processes will operate.

The Anisa Master Teachers' understanding of these developmental processes should give them an appreciation of the kinds of environments they should arrange — including the random (novelty) — as they guide the interactions. They should have a greater understanding of errors of logical typing; and appreciate the discontinuity of experience that requires time for hierarchic development, following the zigzag process of calibration (stability) and process (change). Other more specific applications to each of the Anisa theories can be deduced; for example, analogous processes, operative at the social level of institutional development, are found in the Anisa concepts of administration related to leadership (change) and management (calibration) as they operate in hierarchic organizations.

There is, however, an area of divergence concerning basic conceptual issues. Bateson suggests — but only suggests — that the central problem of Greek philosophy, the problem of purpose which has been unsolved for 2,500 years, may be resolved along his conceptual lines of thinking. It appears to resolve the Platonic form (mind) and matter (body) dichotomy somewhat parallel to the first organismic thinker, Aristotle with his concept of "in rebus." It took the genius of St. Thomas Aquinas in the thirteenth century to appreciate Aristotle's "in rebus" concept as useful in resolving the theological problem of three-in-one found in the father, the son, and the holy ghost. Aquinas, rather than refuting Aristotle, which was his charge, found his ideas useful. The issue that Bateson raises concerning the resolution of the problems of final cause — mostly for mechanistic science — needs to be dealt with more systematically. It is presently divergent with Anisa, but further exploration of this and related problems is merited. There is a wide range of conceptual problems that need to be identified and resolved by that emerging community of scientists committed to the organismic paradigm.

CHAPTER VI

IMPLICATIONS FOR INSTRUMENTATION

Norm-Referenced Tests: Problems and Issues

The mechanistic paradigm converted the problems of measurement, instrumentation, and quantification into puzzle forms that were solved by the rules and procedures developed for the objective-normative tests based upon Fisher's statistical Unit Normal Curve. It is, again, notable that these procedures can be employed for limited purposes within the organism paradigm, e.g., components of research designs, cross-sectional measures, etc., for they can be subsumed as special cases under the organismic paradigm.

In brief, the underlying assumption for Fisher's Normal Curve holds that given traits or characteristics (e.g., intelligence, achievement, interests, etc.) are randomly distributed in the population. The mathematical models used to quantify are primarily statistical based on a normal distribution. Psychometric rules and procedures for validity, reliability, and, particularly, objectivity have been refined over the last three quarters of a century. They are consistent with the mechanistic view which attempts to isolate efficient causes involving independent and dependent variables with the goals of objectivity, control, prediction, and quantification. While the normative, standardized tests have been remarkably successful in achieving these goals, they are only valid within the parameters of the mechanistic paradigm or as special cases in the organismic.

Objectivity was obtained by creating test items which were then administered to a random sample of a given population. This empirical procedure was then statistically quantified which permitted the objective comparison of an individual's test performance with some normative reference group, indicating where the specific individual placed in relation to the normal distribution. In order to assure greater objectivity, the same standardized instructions were used in the administration of the tests. For an instrument to be psychometrically acceptable, validity and reliability studies were conducted. Predictive validity, for example, was largely related to the instrument being able to predict either in the universe assuming that traits once identified are immutable, thereby making prediction possible. The reductionist position was maintained and through ingenuity of design, further refinement of psychometric procedures was theoretically possible.

The rules and procedures for this puzzle solution are now inappropriate given a paradigm shift. The Anisa paradigm, therefore, poses new problems requiring different solutions. The organismic phenomena (facts) that are now the focus of measurement differ significantly from the mechanistic. The concerns are now the measurement of change in the individual and group over time and not merely cross-sectional measures. Measures of hierarchically organized, dynamic complexities — learning to learn — involving newly emergent phenomena pose significant difficulties that need to be converted into puzzle form. Some possible solutions developed by Feuerstein (1979) will be presented below. It is desirable, however, to put into perspective the role of normative psychometrics and the Anisa paradigm. This is a further elaboration of the topic discussed in Chapter III which should now help toward putting some of the pieces of the puzzle into a form that could lead to a solution.

There is an analogy between (1) the paradigm shift from Newton's mechanics to Einstein's general theory of relativity and (2) the normative testing and Anisa theory. The parallel can best be shown by the shift in underlying assumptions of the respective theories. Thus, the underlying assumption of Newton's theory is that the natural state of matter is at rest. His theories were concerned with explaining matter in motion. Given the underlying assumption of matter being stationary unless a force (efficient cause) either directly or at a distance acts upon it, Newton was able to use Euclidean geometry as the mathematical symbol system to quantify his laws of matter in motion. His terrestial and celestial laws still remain valid for matter moving at speeds less than the speed of light and serve as the basis for current engineering, including our remarkable space program.

The above is quite analogous to the development of normative psychometrics. The underlying assumption holds that certain traits (e.g. intelligence, achievement, etc.) are randomly distributed in the population. The mathematical symbol system used to quantify the data is Fisher's statistics, described earlier. The testing technology that has resulted has had great impact upon both psychology and education. Despite some of its limitations cited earlier, the scientific respectability of normative measures in the behavioral sciences still dominates training and practice. Its mathematical base and resultant technology make it comparable to Newton's use of Euclid's geometry while its face-validity is manifest in a significant engineering technology. The training of psycologists and educators solely within the mechanistic paradigm further legitimizes this view of reality, and it would be professional suicide to wholly abandon the paradigm. The mechanistic paradigm will continue to dominate professional training and practice with its view of reality until a new paradigm develops new solutions. Many are intuitively aware of mechanistic limitations, including the legal and ethical problems involved in applying testing technology.

Einstein dealt with the anomalies of Newtonian physics by essentially shifting an assumption from the natural state of matter being at rest to the natural state being in motion. Einstein had to use Riemann's geometry as the symbol system to conceptually account for his hyphenated space-time and matter-energy concept of reality. It did not disprove Newton's terrestial and celestial laws based on Euclid's geometry but made them a special case within his larger general theory of relativity which presents a very different view of nature.

This process is analogous to the assumption underlying normative testing where a random process (entropy) is operative and Fisher's statistics serves as the mathematical symbol system. Within an organismic paradigm, there is a shift in assumption (negative entropy) where an organized complexity is operative. To this writer's knowledge, there is no known or at least accepted mathematical symbol system that can deal with organized complexities. The organismic paratraining and practice. Its mathematical base and resultant technology make it comparable to Newton's use of Euclid's geometry while its face-validity is manifest in a significant engineering technology. The training of psycologists and educators solely within the mechanistic paradigm further legitimizes this view of reality, and it would be professional suicide to wholly abandon the paradigm. The mechanistic paradigm will continue to dominate professional training and practice with its view of reality until a new paradigm develops new solutions. Many are intuitively aware of mechanistic limitations, including the legal and ethical problems involved in applying testing technology.

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Just as Fisher's Unit Normal Curve provided the mathematical base for the entire spectrum of normative standardized testing, it would be highly desirable to have a mathematical system to underpin a testing technology which could measure longitudinal changes in the individual. The computer sciences are providing digital and analogical systems that may prove helpful. Here, digital refers to number and analogic refers to quantity. A combination of these two are probably required to map real world phenomena. As noted above, DNA and neurological processes are digital. A neuron either fires or does not. Physiological somatic processes are analogic.

Beyond the mathematical issues, computer technology provides a means even at the teacher level for gathering observational data on each individual, storing it, and having immediate retrieval. This may prove to be a viable first step in dealing with measurement of longitudinal change in the individual. The data would be the result of participant observation (reciprocal causation) where the data are shared with the individual for mutual decision-making as the teacher guides the quality of interaction in releasing potentialities. It could follow the model suggested by Bateson: form to process or calibration to feedback in the zigzag, alternating steps of hierarchic levels — logical typing.

Current thinking, both in physics and behavioral sciences lean toward some form of statistical mathematics. While mechanistic science holds in principle that everything is predictable and controllable given enough knowledge, this concept is viewed as untenable under the organismic paradigm. Prediction and control are impossible even at the physical level such as breaking a glass or predicting when and what molecule will be the first to go in boiling water. Even in the Brownian movement of molecules, knowledge of what may happen at a given moment does not provide data to predict what would happen next. As Bateson has pointed out, there is a big difference between statements about an identified individual — person or molecule — and statements about a class. These statements are of a different logical type with prediction from one to the other always uncertain. Bateson observes that the statement, "The liquid is boiling", is of a different logical type from, "That particular molecule will be the first to go". Prediction of the movement of planets or chemical reactions which involve aggregates of billions of molecules are possible because the description of the subject matter involves large classes of molecules or individuals. The value to science of statistics rests on this understanding that statistical statements refer only to classes or aggregates, not to individuals.

As a practicing psychologist, I have frequently committed this error in logical typing by predicting the behavior of a given individual based on normative data, appropriate only for a larger class. This is an important insight for understanding and using standardized tests. The problem of evaluating the longitudinal development of a given individual through some form of quantifiable measurement still remains. While a variety of instruments have been developed for clinical evaluation of the individual, e.g., Rorschach, Thematic Apperception Test, etc., none has been as elegant and productive as the normative tests with their excellent mathematical underpinning. It would be highly desirable to have such a mathematical base for the development and growth of a new testing technology for evaluating organismic processes.

At the most speculative and hopeful level, the answer may be found along the lines that Einstein was pursuing. As presented in Chapter III, Einstein did not hold to a statistical view of the universe — most current physicists differ — but felt that behind haphazard appearance, there was a domain of constraints which had a non-statistical basis, hence his statement that God did not play dice with the universe.

While it appears almost imperative to have a mathematical system as a basis for developing a new testing technology to measure changes in the individual over time, that is a problem which may have to be left for future generations. In the interim, there, nevertheless, are insights into new rules and procedures from the organismic approach that may be fruitful for practitioners. These should help in dealing with some of the measurement anomalies — the counterinstances found with normative measures.

Moral and ethical concerns have evolved from the development and use of normative tests; the organismic approach may help to resolve these. Normative testing technology is a product of mechanistic science. Even if a distinction were made between pure and applied science, ethical problems remain. Mechanistic science deals with "what is" (i.e., it is a means) and does not deal with ends. Thus, pure behavioral science concerns itself with issues of understanding the nature of human intelligence and achievement. Having operationally defined the nature of these characteristics, the science then created a testing technology. Some critics make a distinction between problems of pure science — whose goal is understanding and explaining nature — and the application of the technology produced from pure science. This distinction existed in physics particularly. Many theoretical physicists, however, are no longer taking this position and are assuming responsibility for both the intellectual creation of theory as well as the use of the resultant technology. They no longer separate themselves from the ethical and moral problems that result from the application of the nuclear technology — weapons or power plants. This is the fundamental anomaly of mechanistic science which deals with means and not ends.

This is analogous to the behavioral sciences and normative psychometrics. Some behavioral scientists attempt to separate the theoretical understanding from the application of the testing technology.

Thus, ethical problems that arose were viewed as only the result of the misuse of the technology of normative tests and not the result of shortcomings in its scientific theoretical basis. Many behavioral scientists had the same degree of confidence in their view of reality, based on normative statistics, as engineers had in Newton's view of reality, based on Eucleadian mathematics. Both were used as conceptual maps of reality and the basis for sound professional practice.

Psychologists and educators, therefore, in their attempts to base their professional practices on a scientific footing, began the systematic application of the norm-referenced testing technology. Since there was a seemingly objective scientific basis for understanding and measuring intelligence, normative, statistical knowledge was then used to improve educational practice. There is no need to document the exponential growth in measurement since the turn of the century when Binet first attempted to identify intelligent French children who could benefit from education. While it can be argued that educational practices have improved, resulting in greater benefits to children, there are, however, serious technical as well as ethical limitations to the use of norm-referenced tests.

For example, Whitney Griswold, the late president of Yale University observed in one use of standardized tests that at about age eleven, an English chid is reduced to an abstraction and becomes a part of a formula which predetermines the rate and extent of his total education. This "creaming and streaming" concept is based on intelligence testing which assumes intelligence is a stable, unchanging trait that can predict future performance. The comparison of the merits of homogeneous vs. heterogeneous grouping is not the central issue; but, rather, there are the related ethical concerns at several levels. Beyond the technical issues of selecting the appropriate test, etc., there is the ethical problem of invading the privacy of the individual through either group — or individual — testing and then having the institution make decisions about placement in whatever "track" without the participation of the individual. The educational institution in applying the use of "objective scientific instruments" creates ethical problems at several levels. This institutional decision-making violates a range of values related to the Judaic-Christian and constitutional democratic beliefs about the locus of control and responsibility resting with the individual. Some psychologists attempt to lessen the degree of ethical conflict by invading the privacy of the individual with prior permission and then presenting the results to the individual for his own decision-making. This latter practice can be further rationalized as a means that a teacher can use in determining the intellectual potential of a child in order to plan a program that would allow the student to achieve his highest potential. This teacher-practice would, therefore, be consistent with implementing an educational goal that currently has a wide national consensus with boards of education, under the guise of developing each student to his highest potential.

These several levels of ethical concern pose major problems for the application of normative psychometrics. At the theoretical level, it is impossible to make the distinction between pure and applied science. Both the theoretical base and psychometric technology are the products of mechanistic science with all of the associated anomalies previously discussed, particularly those related to efficient causes, objectivity, prediction, control, and means-rather-than-ends.

The Anisa paradigm as the basis for a new educational science deals with the theoretical and applied distinction by hyphenating the means-ends issues. Since it is a prescriptive theory, it deals with the moral and ethical "ought" issues. The volitional locus of control is centered in the individual. As he grows, subjective aim and final cause help him to progressively gain more control of his destiny. This eliminates treating the individual as an object. Professional intervention is involved, therefore, in treating the student as both object and subject. If any testing is conducted, prior permission and sharing of findings are necessary conditions for mutual decision-making. The Anisa theory of education serves as the prototype for all professional practices. This approach is largely congruent with the Judeo-Christian Western World values concerning the individual and particularly democratic constitutional beliefs about man. Thus, the need to discover and invent instruments to measure changes in the individual over time for the mutual benefit of both the teacher and the student.

Where normative tests are employed, it is vitally important not to commit an error of logical typing. The Anisa paradigm makes a significant contribution to psychometrics by putting in perspective the appropriate use of normative tests. It is important to understand when using normative tests that they only give more information about the aggregate — the group — and not about the individual. This is the most frequent error made by test-users where normative test data are misused in making predictions about the single individual. As discussed on page 153, this is an error of logical typing; statements about the individual are at a different level from statements made about the group. Anisa does not, therefore, preclude the use of normative tests but places them in this perspective with limited usefulness.

Anisa takes into account the subjective aim and purposes of the individual and appears to resolve some of the ethical problems discussed above regarding the use of normative measures. There are, nevertheless, situations (i.e., national emergency) — a higher level of logical typing — where the survival of the group transcends the individual and the society may use standardized test results for more effective mobilization of groups.

Norm-referenced tests continue to play an important role in current psychometrics. Ronald K. Hambleton estimates that approximately 95% of the tests reviewed in the eighth edition (1978) of Oscar Buros' Mental Measurements Yearbook are norm-referenced. It is interesting to note that Oscar Buros observed that relatively little of significance had been contributed to normative psychometrics since their heyday in the 1920's and 1930's. Normative psychometrics does have a role in Anisa practice; therefore, some of the more specific problems of the growing anti-normative test movement will be discussed. Three new approaches that are more consistent with Anisa practices will be presented in the following pages. While these approaches do not convert the problem of longitudinal change into solvable puzzle form, they represent testing technologies that point in the right direction and are immediately available for application.

Constructive alternative to norm-referenced tests. The first approach is represented by Feuerstein et al. (1979) in his psychometric assessment of educability with his "Learning Potential Assessment Device" involving theory, instruments, and techniques. The second is concerned with criterion-referenced tests first introduced by Glaser (1963) and Popham and Husek (1969). The third is represented by the initial efforts of Hambleton et al. (1974) in developing instruments for measuring aspects of the Anisa process curriculum.

Reuven Feuerstein, who studied in Geneva under the direction of Jean Piaget, over a period of twenty-eight years used his clinical observations as the basis for developing the "Learning Potential Assessment Device" (LPAD) which is a radical modification of conventional psychometric theory. He provides an innovative approach to the assessment of educability based on his work with low functioning children and adolescents migrating to Israel. On conventional intelligence tests, the children generally lagged from three to six years behind the norms of middle class children. A review of a wide range of "non-verbal", "culture-free", and "developmental" tests supported the diagnosis of cognitive deficits. Feuerstein's approach, however, was not only to identify the deficits but to determine if they could be reversed. The influence of Piaget and the Geneva group put Feuerstein on the path to a solution with a hierarchical conception of knowledge and skills. His approach reverses a number of honored presuppositions of norm-referenced psychometric theory and practice.

The empirical evidence in support of his theory, instruments, and technique employed over a twenty-year period are documented in elaborate case studies. J. McVicker Hunt, who observed Feuerstein using the LPAD with adolescents with conventional IQ's in the sixties, reported a dramatic case involving a boy aged thirteen with a conventional IQ of 70 who later earned a Ph.D. in psychology from the Sorbonne in Paris. Feuerstein's cases demonstrate that a large degree of plasticity and modifiability (through appropriately "mediated experiences) exists, even at adolescence. This is consistent with the Anisa philosophical view that human potential is unlimited, given no excessive organic damage to nerve tissue.

Conventional, norm-referenced intelligence tests measure intellectual abilities operative at the time of testing, which are then used to predict future achievement. Feuerstein's approach considered that the development-fostering quality of past experiences had great effects on cognitive processes that make up intelligence test items. What he attempts to determine is the degree to which the effects of cultural deprivation can be reversed by providing the necessary and sufficient experiences. Again, the Anisa view holds that the performance on any test primarily samples the "immanence" of the individual being tested. He can't produce a response if the stimulus doesn't connect with some past experience stored in memory. The LPAD is used to assess how much an individual's cognitive functioning can be modified. Its focus differs radically from conventional psychometrics whose concern is with the products of cognitive functioning toward predicting future performance. The LPAD shifts the focus from product to process and to modifiability of the process of cognitive functioning with the goal of determining ways it can be improved. When interpreting results, the "product orientation" of conventional psychometrics ignores the infrequent, high quality response as representing an error, whereas the "process orientation" uses such high quality responses to identify strengths and remediation and education.

The second major modification of psychometric practice, as adopted by Feuerstein, is the shift in the examiner/examinee interaction — one that is totally consistent with the Anisa theory of teaching and epitomizes Gadlin's prototype of the experimenter-subject interaction as the basis for a new experimental research methodology. In contrast to the objective, neutral role of the examiner giving standardized instructions, we have a shift to one of teacher-pupil or examiner-teacher guiding the interaction in the "testing" situation. Feuerstein observes that the examiner-teacher "constantly intervenes, makes remarks, requires and gives explanations whenever and whereever they are necessary, sums up experience, anticipates difficulties and warns the child about them, and creates reflective insightful thinking in the child not only concerning the task but also regarding the examinee's reactions to it". The relationship of the examiner and examinee for Feuerstein contrasts dramatically with the traditional psychometric approach: the examiner and examinee are "engaged in a common quest for mastery of the materials". The examiner's role is fully analogous with the Anisa theory of teaching applied to the assessment process — a teaching-training relationship. Feuerstein states that this teaching "is not merely oriented toward a specific content, but includes the establishment of the prerequisites of cognitive functioning for a wide array of problem-solving behavior." Feuerstein's approach is a major revision of conventional psychometric practice. His concept of "mediated experience" as different from "direct experience" of the environment also parallels the Anisa concept of "learning-to-learn."

J. McVicker Hunt, an outstanding psychologist, makes the following observation about Feuerstein's (1979) work:

> Even though conventionally objective psychometricians may still have qualms about the clinical ingenuity required of the examiner-teacher and about the subjectivity still involved in quantifying the amount of effort the examiner-teacher must invest in getting examinees to appreciate the cognitive and motivational schemata required of them, psychometric assessment of educability should never again be the same...Other investigators can build upon the very substantial foundations that Feuerstein has constructed (p. xi).

His theory, instruments, and technique are fully consistent with the Anisa paradigm and represent an important empirical base for solving some of the instrumentation puzzles encountered by the organismic paradigm. His LPAD is not only a battery of tests but a model for the construction of "dynamic tests" that could represent the first significant step in the development of a testing technology that is necessary for implementing Anisa theory. Since the implications are potentially very significant, a further elaboration of these problems, i.e., predictability vs. change, product vs. process, examiner/examinee interaction, mediated learning, and the LPAD battery, will be presented and related to Anisa practice.

The development of norm-referenced psychometric measurement has relied upon mechanistic research procedures using the conventional statistical approach. The statistical concerns are generally related to reliability and validity. According to the organismic view, the primary issue of education cannot be solved by improved levels of test reliability and validity for education is concerned with changing the individual's cognitive functioning and not stabilizing it. Bereiter (1962) makes the observation: "...the only reasonable evaluation of an educational practice is one that measures...changeable traits. But the tests available for use in such evaluations are designed as predictors of future status, and in order to be good predictors they must be insensitive to the very changes the educator is trying to produce and measure." Mechanistic thinking with its goal of prediction and control, reflected in striving for increased reliability and validity, has dominated psychometric practice. As a consequence, there has been very little concern for the development of instruments for measuring change. The "prediction" approach, nevertheless, has attained scientific legitimacy; the "educational" approach, however, remains questionable and risky. The paradigm shift to organismic thinking is the key to legitimizing the latter.

There is growing evidence within the field of psychometric measurement that the underlying assumptions of measuring procedures are highly suspect. The assumption, for example, that intelligence is randomly distributed, based on a mathematical (statistical) assumption concerning the nature of reality is now suspect. As previously discussed, this assumption is challenged by the shift in assumption from entropy to negative entropy. At a more operational level, conventional psychometric methods estimate the intelligence of individuals by measurement relative to age norms. Individuals are compared with respect to their relative mastery of the products of prior learning. This makes the patently erroneous assumption that the individuals being compared have had an equal opportunity to learn. The empirical evidence does not support such an assumption.

The evidence, in fact, is to the contrary in that scores on both group and individual intelligence tests vary according to membership in a particular socioeconomic class, years of schooling, and level of education of parent (Karp and Sigel, 1965). Variations on these factors aren't viewed as counter-instances but rather as variations in the individual's potential which represent stable differences in the individual's course of development. In addition, the stable differences are then ascribed to one or a combination of the following: (1) genetic factors which are immutable; (2) organic factors which are also hypothesized as irreversible; or (3) experiential background that adversely effects intelligence and is irreversible after certain critical periods. The observed performance differences, therefore, maintain their predictive value under all of these conditions.

There still remains a great deal of interest in research concerning performance on an IQ test and its relationship to genetic factors

(Jensen, 1973; Herrnstein, 1973; Eysenck, 1971). The data and their interpretation are varied depending on methodological issues. The argument based on the available data suggests that there is inadequate support for genetic endowment differences in intelligence or that the environment is the major determinant. Kamin (1977) reanalyzed these data and concludes that there are no reliable scientific data to support a purely genetic view of intelligence. A related issue is concerned with the nature of the IQ test itself. This is Feuerstein's major concern regarding the meaning of an IQ score. Feuerstein (1979) states,

> Beyond providing a measurement of manifest performance at a given time and within a given context of past experience and opportunities to learn and benefit from such experience, there is little reason to assume or accept that performance on IQ tests provides a stable or reliable measure of future performance (p. 5).

Evidence from a variety of studies indicate that situational variables have a significant effect on test performance (Cronback, 1975; Hunt, 1975). While acknowledging that genetic (digital) determinants are less accessible to change, other components (analogic) have a much heavier impact on overt behavior and make predictability from intelligence test scores even less reliable. Feuerstein questions the degree to which genetic or organic determinants should be considered unchangeable under all possible conditions.

The entire field of psychodiagnosis and particularly measurement of cognitive functioning has come under serious question even by many who were initially very supportive (Cronbach, 1975; Anastasi, 1976; Thorndike, 1971). The disenchantment, however, is primarily related to existing norm-referenced techniques for measurement. Nevertheless, there is growing concern for gaining knowledge about cognitive functions. Problems of adapting to our cultural environment with its discontinuities are creating stresses that require new adaptation to changing situations. In order to cope with new conditions, each individual needs to develop the ability to modify himself — to learn-to-learn. However, the increased importance of measuring cognitive functioning appears to be inversely related to the ability of norm-referenced procedures to fulfill this need. Very little progress has been made in this direction; however, it is of primary importance for implementing the Anisa process curriculum.

Beyond the concern of the IQ test score itself is the underlying assumption of the conventional psychometric approach that intelligence is a substance. This assumption of the immutability of cognitive capacity represents a view of intelligence as a fixed entity that can be evaluated relatively accurately even at early stages of development. It follows, therefore, that measuring devices can penetrate layers that constitute the natural endowment. This is analogous to treating intelligence as an object whose mass can be measured reliably and whose permanence is maintained in spite of external changes. E. L. Thorndike observed that if something exists, it exists in some amount and, therefore, should be able to be measured. However, as Wesman (1968) points out, we need not hold the converse notion that if something can be measured it has existence as a substance. Wesman (1968) states:

> So preoccupied have we been with reifying intelligence as some mystical substance that we have too often neglected to take a common-sense look at what intelligence tests measure. We find ourselves distressed at our failure to

> predict with satisfactory accuracy the intelligence test scores of a teenager from his intelligence test scores as an infant. Why should this occasion surprise, let alone distress? If we look inside the tests, it should be obvious that the kinds of learning we typically appraise at the earlier ages bear little resemblance and may have little relevance, to the kinds of learnings we appraise later (p. 271).

The solution to the problem by conventional psychometric methods is to increase the reliability and validity of the tests which results in the solution becoming the problem.[1] For example, stable characteristics are selected; items that do not show reliability (ones too sensitive to environmental factors and modifiability of the individual) are rejected in favor of those that do not show this sensitivity. Thus, functions that reflect adaptability of the individual are considered unreliable and nondiscriminatory among individuals and are, therefore, not considered for measurement. Modifiability is not considered a relevant dimension of the organism and is not worthy itself of becoming an object of psychometric measurement. The negative consequence of this thinking leads to the belief that what is not measured does not exist;

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[1] Watzlawick et al. (1974) observe that some problems are solved by providing "more of the same" as when the temperature falls in a room one can provide more heat or warm clothing until the desired effect is achieved. However, this "logical" type of problem solving does not apply to many situations; for some, the solution becomes the problem. For example, the insomniac's solution to the problem of falling asleep is to achieve sleep by an act of will power (e.g., thinking about not thinking) only to find that doing this is actually what keeps him awake. Since sleep by its very nature can occur only spontaneously, it cannot occur spontaneously when it is willed. Thus, the attempted "solution" of "more of the same" intensifies rather than solves the problem.

thus, modifiability of the individual is not assessed because such modifiability does not exist. Feuerstein believes (fully consistent with Anisa) change should be introduced as the central goal of assessment, and situations should be created in which change can be elicited and then measured for it is change (growth) educators seek to provide.

Feuerstein seriously questions the predictive (stable) approach which holds that data collected at any point along the individual's development can then be used to predict the development to be expected in the future. Adherence to prediction as a major goal of mechanistic science often precipitates immediate institutionalized custodial care when applied to the assessment of an individual that may eventually require lifelong custodial care. Psychologists and pediatricians frequently prefer immediately placing a child, who may later need custodial care, in such a facility to avoid prolonging the uneconomical and emotionally stressful relationship with such a child. Acting on such a recommendation leads to the fulfillment of a child's predicted development because the custodial conditions serve to perpetuate the very conditions that were the basis for the initial prediction.

Feuerstein cites hundreds of custodial cases in his files who were referred to custodial care but not placed. Instead they were reared in stimulating environments by parents and educators. Using the Learning Potential Assessment Device, he found generally high modifiability on many of these children which resulted in significantly higher levels of functioning. His case studies offer a substantial empirical base in support of the educational (modifiable) approach. These are coupled with Cobb's (1972) observations concerning cognitive capacity:

> ...the hundreds of investigations...have made it quite clear that intellectual capacity is not a unitary function but a complex of overlapping, partially independent functions. Various test instruments measure various facets of these complex variables. The functions themselves are subject to modifiability by other internal development factors and by external influences ...The interactions of cognitive with non-cognitive functions in adaptive behavior are extraordinarily complex, especially as learning accumulates over time (p. 144).

Problems of labeling. Since I perceive my role as a loving critic vis a vis conventional psychometric procedures, it is desirable to put the use of intelligence testing in a larger sociological context. With respect to the technical and empirical issues, the Anisa paradigm subsumes their use as a special case with the associated limitations already discussed. Economic, political, and social issues are involved in psycho-diagnoses particularly through pupil placement laws which use tests to fortify an existing social system. Problems of disadvantaged and frequently exceptional children are related to power; power structures representing these groups are often in a powerless position. Thus, psychometric procedures discriminate in many ways that are at odds with stated societal values, resulting in a loss of human potential from those cut off from the mainstream culture — the culturally different, minorities and, particularly the low functioning ("retarded") groups. Disproportionate numbers from these groups have been diagnosed, classified, and treated as educable mentally retarded (EMR) based on standard psychometric procedures. Havighurst (1964) and Mercer (1973) demonstrate that 80% of children classified as EMR come from particular socio-economic and ethnic subgroups. These findings have surfaced outside of the professional educational community, raising serious questions concerning validity of diagnostic tests and resulting in court rulings against psychometric measurement. It is now an issue in civil rights and the subject of congressional and state legislation.

The anti-test movement has been spurred by significant evidence demonstrating the damaging effects the use of intelligence measures have upon individual's prospects in life. The major negative aspect is the offering of a diagnostic label, particularly "retardation." While only specific aspects of the person's functioning may be involved in the diagnosis, it is the total person who is labeled and reacted to, accordingly. Retardation and delinquency, particularly, involve a formal diagnostic labeling process, but, as Goldstein (1975) observes, there is no such process for the removal of a label.

Feuerstein focuses on the damaging effects of labels particularly for "retarded" children. Mercer's (1975) study of the practice of labeling persons as retarded in Riverside, California showed Mexican Americans to be 300% and Blacks 50% over-represented in the groups labeled retarded. These practices are seen as violating the basic rights of children by tracking children into what Feuerstein calls "educational poverty."

Labels take on broad and diffuse meanings which, when institutionalized, serve as devices people use to orient themselves with respect to others. The effects of homogeneous grouping, which was initially intended to allow teachers to address deficiencies and avoid having children frustrated by difficult tasks, have raised serious doubts about this practice. Evidence has mounted showing that a low achievement label applied to a member of a homogeneous group carries a stigma that is more damaging than a low achievement label attached to an individual from a heterogeneous grouping. Special education classes designed to remediate problems diagnosed in mainstream classes are frequently one-way streets with no means of escaping the label. Some large cities have less than ten percent of special education children returning to the mainstream. Recent federal legislation (PL 94-142) mandating identification of all "exceptional children" and providing a free and appropriate education in the least restrictive environment supposedly addresses this problem. The impact of this legislation will need to be evaluated.

When considering the current psycho-diagnostic procedures used in identifying (labeling) the exceptional child, it appears the attempted solution to the problem of the exceptional child may also prove to be the problem. Feuerstein's dynamic assessment procedures used within the Anisa framework may prove to be a constructive alternative to the bourgeoning growth of special education with all the damaging effects of labeling. The application of the Anisa paradigm supported by Federal and local funds to both the mainstream and special education in five cooperating towns in Connecticut should provide empirical evidence in support of this hypothesis.

<u>Predictability versus modifiability</u>. Having presented some of the issues involved in conventional psychometrics related to predictability vs. change (modifiability), Feuerstein clarifies his shift from a pro-

duct to a process orientation. Standardized testing procedures can be criticized because they are concerned with the end product and disregard the process that produced it. Conventional testing has limited provision for recording and evaluating the process by which the examinee produced the final, recorded, and weighted answer. There is no attempt in the design of the tests to elicit information concerning the process of how the examinee arrived at an answer. The search for stable characteristics of the conventional approach limits the interaction between the examiner and examinee. Any deviation from the standardized directions supposedly vitiate the results. This approach does not regard situational variables including sex, race, interactional style of the examiner, familarity with tasks, time pressure, and anxiety have an effect on test-taking performance.

The differential backgrounds of the examinees also influence the test results. Feuerstein gives an example of evaluating the intelligence of two dogs, one of which had been trained with a well established conditioned reflex while the other had not. Obviously, this is an absurd comparison for the real question would ask if the second dog, given an appropriate investment of time, would be able to display the conditioned reflex. This is analogous to humans; however, conventional psychometrics regards intelligence as fixed and places emphasis on eddogenous factors. Thus, conventional approaches largely disregard situational and environmental background variables. Their focus is on the individual's capacity for functioning and the manifest level of functioning with disregard for his functional efficiency.

Feuerstein makes an important distinction between manifest level of functioning and capacity in relationship to functional efficiency. The latter is concerned with such variables as fatigue, level of vigilance, recency of task acquisition and speed of performance, anxiety, and lack of maturation. It is an integral dimension of cognitive measurement which needs to be considered, for errors in performance may reflect problems of efficiency and not capacity. Conventional psychometric tests, with their product-oriented approach, use an inventory of function held to be the individual's capacity. This product-oriented approach, which measures only the end product and not the process, does not consider the many sources of error. In addition to errors from functional inefficiency, errors may result from inadequate or inappropriate input data, inappropriate data elaboration, or inappropriate data output. The product orientation also uses the method of summarizing sources in the form of the quotient, index, percentile, or an average. This sampling of products leading to quotients wipes out intra-individual differences. A process orientation, however, looks for uniqueness — the intimate structure of behavior, particularly peaks of performance and deliberately searches for understanding of such peaks.

A product orientation in testing, therefore, fails to provide the necessary data about each individual's specific strengths and difficulties. Feuerstein maintains that the goal of assessment should be understanding the process that brought about the particular level of functioning and this should be the basis for intervention. The failure — and even harm — of special education programs in their response to recommendations from norm-reference testing to bring about remediational changes in children, is the result of not having such meaningful data on each child.

Feuerstein reviews the attempted alternatives to conventional testing which devised new instruments or modified existing ones. These were based on essentially two concepts: the cultural difference model or the deficit model. The cultural difference model explains gaps as an artifact of testing. Thus, the overlap between different cultures in intellectual functioning which can be measured is not large enough to assure the relevance of a test for one cultural subgroup when the test was designed for another. Attempts to deal with this involves maintaining the conventional tests but constructing separate norms for the different cultural groups, or translating tests into different languages for the subgroups, or the development of separate tests for the different populations.

The deficit model, on the other hand, explains observed differences as reflecting cognitive deficits which characterize individuals of low-functioning groups. Culture has an impact on these differences but the deficit model does not assume different cultures have inherently different types of intellignece as in the cultural difference model. Jensen (1969) proposed a deficit model that considers deficiencies as immutable based primarily on genetic factors which would essentially preclude any investment for intervention to close these gaps. Within the deficit model, but in contrast with the Jensen view, is the position that holds that the observed deficits do not represent real incapacities which are immutable but are determined by deficiencies in certain prerequisites of cognitive functioning. The differential effects of nature and nurture do not reflect stable conditions but are subject to change by appropriate approaches and techniques within an investment/learning ratio which can be determined by assessment procedures. This view is consistent with Piaget, Anisa, and represents Feuerstein's basic position.

A number of modifications and changes of conventional psychometric procedures have been introduced to deal with the cultural difference and deficit models. To cope with the problems raised by standard psychometrics, culture-free or culture-fair tests, developmental tests, and inventories of adaptive behavior have been tried. The results, however, still fall under the static model of assessment which evaluates present and manifest cognitive capacities. None of these instruments searches for the child's potential for being modified by learning. There is a growing awareness of the limitations of conventional psychometrics and an emerging need to focus efforts on the development of techniques and instruments to evaluate changes in the individual (patterns of learning disability and potential for learning) using, initially, a process of qualitative analysis rather than quantitative assessment.

Dynamic assessment. In response to this formulation of the problem, Feuerstein developed a dynamic approach for the assessment of modifiability through focussed learning; thus, establishing the potential for being modified by learning as the goal for psychometric assessment. It represents a radical departure from conventional procedures, replacing the static goal of assessing manifest capacities with a dynamic goal of assessing manifest capacities with a dynamic goal of measuring the degree of the individual's modifiability by providing him with a focused learning experience. Therefore, a measure of the individual's learning potential is obtained which, simply defined, is his capacity to become modified by a learning process. For Feuerstein, the evaluation of intelligence is a process of measuring modifiability during active learning which diametrically differs with the view that intelligence is determined by some unchangeable genetic and environmental factors. This view of intelligence is a result of a complex interaction between organism and environment expressed as a capacity for modifiability through learning. In Anisa terms, modifiability through learning means actualization of potential.

Assessment procedures for educational purposes, therefore, should not be primarily concerned with inter-individual differences. Instead, there should be a detailed and thorough study of each individual that will enable the educator to induce some modification in the speed and accuracy with which learning takes place. No labels are then necessary since high level detailing of each individual's functioning over-shadows the need for general categories for describing the manifest behavioral level. The manifest level — usually the goal of conventional testing — is the beginning point for Feuerstein's dynamic testing. Labels are irrelevant and misleading regarding the careful assessment of the individual's capacity to learn. This dynamic, interactional view of intelligence reflected in assessment where the examiner and examinee interact as teacher and student epitomizes the Anisa theory of pedagogy.

Whether the assessment procedure is conducted by differentiated staff, (e.g., psychologist) or the Anisa Master Teacher, the goal of the diagnostic process and the educational intervention remains the same.

The dynamic assessment approach requires changes in the following areas: (1) structure of the tests; (2) the examination situation; (3) orientation of the tests, and (4) interpretation of results. The Learning Potential Assessment Device (LPAD) incorporates these features.

Test structure. The LPAD clinical battery includes the following tests: Organization of Dots, Raven's Progressive Matrices (A-E, including LPAD Variations), Plateaux Test I-II; Representational Stencil Design; Numerical Progressions; Positional Learning Test, and Verbal and Figural Analogy Test. These test instruments were selected and altered in a way that provides the examiner and examinee with tasks involving a teaching process that enables the examiner to progressively evaluate the effect of the teaching on the capacity of the individual to deal with new situations. Each test presents items that induce preparation for subsequently more difficult items (e.g., Raven's Progressive Matrices). When test items are presented according to standardized instructions, the examinee is left with inadequate preparation and feedback for dealing with the subsequent, more difficult items. For the individual, exposure to each task modifies him in a way that permits him to approach the more complex tasks more successfully. This approach assesses the modifiability (learning ability) of the individual when confronted with conditions aimed at producing a change in him. It is possible to assess levels of modification attained in the hierarchy of cognitive operations (e.g., is the achieved modification limited to elementary perceptual functions or other higher level mental processes such as abstract or logical operations). In addition, assessment is made of the amount of teaching investment that will be required to assist the modification as well as the preferred modalities, relative strengths and weaknesses, etc. Feuerstein presents clinical and experimental data obtained from the application of each test. He has also adapted the tests used in the LPAD for group testing.

Examination situations. Changes in the instruments, although they are the most vital component, are not, by themselves, sufficiently effective to assess the modifiability of the individual. The testing situation is also changed in a way that parallels the changes in instrumentation. The shift is from a static to a dynamic goal in the test situation that turns the examiner into a teacher-observer and the examinee into a learner-performer. This shift requires a number of changes in the usual interaction with a particular emphasis on establishing a two-way communication process. There is, therefore, a change in examiner-examinee interaction and the introduction of a training process as an integral part of the LPAD measurement.

In assessing the cognitive functions of an individual, Feuerstein asserts that deficient functions are not missing from the cognitive repertoire but are functions that are underdeveloped, poorly developed, and/or impaired. Under certain conditions, particularly where strong need exists, appropriate functioning may emerge. It is helpful to understand the nature of deficient functioning by identifying the lows of occurance in terms of the phases in which they occur. There are three phases of the mental act: (1) the input phase, (2) the elaborational phase, and (3) the output phase.

<u>Input phase</u>. Problems occuring at the input phase include all the impairments dealing with the quantity and quality of data the individual gathers in understanding the nature of the problem as preparation for attempting a solution. The following briefly illustrates some of these impairments: (1) sweeping and blurred perception, (2) impulsive exploratory behavior, (3) impaired verbal labels that preclude differentiation of objects, events, etc., (4) no sense of the need for accuracy in data gathering, and (5) the inability to consider two or more sources of information. The examiner may find that these impairments at the input phase, operating alone or in combination, result in a deficiency in "readiness for response." The response will be inadequate in terms of the appropriate solution to the problem because the necessary data did not become available to the examinee. These impairments at the input phase may, but not necessarily, affect the functioning at the elaboration and output phases.

<u>Elaborational phase.</u> The elaborational phase includes those factors that impair the individual's efficient use of data available to him. Beyond the impairments of data-gathering at the input phase, the following illustrate those deficiencies that operate to impede the appropriate elaboration of the cues that do exist: (1) little or improper differentiation of actual problem, not selecting relevant from non-relevant cues, (2) no awareness of how data have to be integrated by

pursuing logical evidence, (3) impaired inferential "iffy" thinking and strategies for hypothesis testing, (4) impaired planning behavior, and (5) non-elaboration because necessary verbal concepts are not in the individual's repertoire. Feuerstein treats the elaboration of cues as synonomous with the general meaning of the word "thinking." In Anisa terms, elaboration would be equivalent to "cognitive processes."

Output phase. Deficiencies at the output phase include those that result in an inadequate communication of the final solution. Although adequate input data and appropriate elaboration are present, difficulties may result from inappropriate expression (i.e., the person may know the solution, but can't articulate it). The following briefly illustrate specific deficiencies: (1) egocentric communicational modalities, (2) blocking, (3) trial and error responses, (4) impaired verbal tools, (5) lack of need for precision and accuracy in communicating, and (6) impulsive, acting-out behavior.

In assessing performance, the examiner should not view any of the preceding cognitive impairments as any real lack of capacity, but rather ineffective attitudes, faulty work habits, and inadequate thinking modes — all functions that can be improved through training. Feuerstein, in fact, believes that impaired cognitive functioning is the result of "inadequate and insufficiently mediated learning experience." He postulates that cognitive impairments are not directly related to poor genetic or organic deficiencies but result from the "absence, paucity, or ineffectiveness of adult-child interactions that produce in the child an enhanced capacity to become modified, that is, to learn."

A distinction is made between learning through direct exposure and mediated learning. The two major learning modalities occur simultaneously but with different emphasis during different stages of development. Direct exposure learning results in the modification of the developing individual through direct contact with environmental stimulation (objects and experience of events) — analogous to Piaget's process of accommodation and assimilation. Feuerstein (1979), on the other hand, conceives of mediated learning experience as

> ...the interactional processes between the developing human organism and an experienced, intentioned adult who, by interposing himself between the child and external sources of stimulation "mediates" the world to the child by framing, selecting, focussing, and feeding back environmental experiences in such a way as to produce in him appropriate learning sets and habits (p. 71).

Thus, mediated learning, in contrast to direct exposure learning of chance confrontation with objects, is the result of the adult's intervention. What is most significant is the "intentionality" on the part of the mediator who sets the meaning of the experience and makes the learner aware that he is involved in a process of learning something that transcends the immediate situation involved in the interaction. The more an individual has benefited from mediated learning, the greater will his capacity become to be modified through direct exposure learning. Mediated learning is a prerequisite to effective, independent growth which results in reflective thinking, inner representation, and emergence of operational behavior. Feuerstein's concept of "mediated learning" parallel's directly Jordan's view of "learning competence" through learning-to-learn where the learning-to-learn means the "conscious ability to differentiate, integrate, and generalize experience". Conscious ability depends on the capacity to symbolize. The Anisa Model sets forth three basic symbol systems: language, math, and the arts. They function also as mediators. Teaching, according to the Anisa Theory, is arranging environments (which regulates the quality of direct-exposure learning) and guiding the child's interaction with the environment (a form of intentional intervention that "mediates"). Much of the mediation is accomplished by the teacher through the use of symbols, which stand between (mediate) the objects in the environment and the child.

Given the theoretical importance of mediated learning, Feuerstein significantly alters the examiner-examinee relationship in order to reach the dynamic goals set by the LPAD. However, conventional psychometric tests are characterized by a uniform set of procedures with no deviations. A neutral, even sympathetic but basically unresponsive examiner limits his interaction with the examinee to dry, standardized instructions. The examinee's limited grasp of the instructions coupled with a possible lack of motivation toward difficult tasks may lead to a tuning-out or to higher anxiety involving feelings of threat and expectations of lowered success. The examinee may interpret the first as not-caring with the same not-caring of the examinee. The neutrality of the examiner, however, may be interpreted as hostility and an expectation of the examinee's failure which further reduces the examinee's efficiency through lowered motivation and counter-hostility. The examinee's attempts to lessen these effects by encouragement are quickly perceived as lip-service because these expressions prove false in his continued experience of failure with the tasks presented.

The LPAD technique radically changes the roles of the examiner-examinee to a teacher-pupil role. The neutral, indifferent role is shifted to an actual, cooperative role of the teacher who is greatly concerned with the success of his pupil. Feuerstein characterizes the examiner as one who constantly intervenes, makes remarks, requires and gives explanations, asks for repetitions, sums up, warns child about difficulties, and promotes reflective, insightful thinking in the child to the tasks and the examinee's reaction to them. The examiner is active, involved, and gives examinee the feeling that the tasks are important, difficult, but manageable. This change in role usually results in a sharp increase in motivation which, of course, influences performance. At first, it is extrinsic, with the examinee motivated to please the examiner. There is a later shift to intrinsic motivation where the examinee delights in the task itself, having grasped its deeper meaning and no longer feeling overwhelmed by it.

This positive approach to problem-solving results in increased mastery of tasks since the sequence of tasks on the LPAD progressively increase in difficulty. Mastery raises the need in the child to respect the experience; this, in turn, has functional value in consolidating a successful pattern of behavior as Piaget describes. There is also an increase in aspiration and motivation wherein the task becomes the center of interest and motivational focus and the examinee is no longer primarily motivated by the examiner. This change in roles and interaction on the LPAD by an examiner who now becomes a teacher-trainer with an examinee (turned pupil-trainee) results in the pupil becoming aware of the meaning of the task, the importance of mastering it, his ability to do it, and using a feedback process, the ability to select behavior leading to success. Feuerstein believes that in this kind of testing the personal change in examiner-examinee relationship is a necessary condition for the appropriate assessment of modifiability of, specifically, culturally deprived children. This is also a prototype for the necessary assessment of children by the Anisa Master Teacher and/or differentiating staff.

Orientation of tests. The orientation of the tests, which represents a shift from product to process orientation, is the third major change that is necessary to turn the static approach into a dynamic one. Such a shift is an integral part of the LPAD. Conventional test construction makes little provision for recording or evaluating how the examinee arrived at the final product. The goal of many psychometric tests is evaluation of the product for the purpose of selecting personnel. However, when the assessment goal is remediation and education, not selection, the problem is understanding how an individual's functioning can be modified. The process, therefore, becomes as important as the product. Many of the clinical projective techniques have provisions for evaluating process on a qualitative basis. Similar provisions are made with the LPAD where each response of the examinee is recorded for a thorough analysis. In the interaction, the child is asked to clarify his responses which gives access to the processes underlying his cognitive functioning.

For his process-oriented approach, Feuerstein developed a cognitive map which includes the following seven parameters by which a mental act can be analyzed, categorized, and ordered: content, modality, phase, operations, level of complexity, level of abstraction, and level of efficiency. The use of such a cognitive map, obviously, requires a clinical assessment situation.

Test interpretation. The interpretation of test results is the fourth area of difference from conventional psychometrics wherein peaks in the pattern of performance are used as an indication of the cognitive potential of the examinee. This change in approach to the interpretation of the results may be possible while still conserving some of the more conventional aspects of assessment. The primary concern in interpreting results is the way the examiner handles the peak performance — a sharp, isolated, and unique departure from the established pattern of poor responses made by the child. Such responses are generally ignored in conventional testing for selection purposes. However, for purposes of assessing for education, these rare, high quality peak performances are significant in understanding the individual more fully. In Anisa terms, they may represent aptitudes and interests that reflect subjective aims. To learn how subjective aim operates in the life of a child is to have in hand a key that unlocks the door to understanding the child in his specificity. The LPAD intervention procedures, with their focus on the assessment of modifiability, frequently changes the course of the results by an insight created in the examinee by the tests and new interactive process. The single peak response, Feuerstein has found, may serve as a more valid predictive criterion than failure on a whole battery of tests. These responses become the point of departure for probing the more hidden cognitive functioning of the individual and for attempts to modify it. In Anisa terms, the peak response is the expression of transcendence — a bursting forth of a bit of actualizing potential. There is where the future of the child is — where the well-springs of hope are — that is where teacher and pupil should make their investment.

Summary. The dynamic assessment of the LPAD, its philosophy, method, instruments, and techniques have significant implications for they are fully consistent with the Anisa practices and can be immediately incorporated. The dynamic assessment procedures are analogous to the Anisa theory of teaching; on most dimensions each could serve as a prototype for the other. The LPAD, therefore, can be used by the Anisa Master Teacher or differentiated staff (e.g., psychologist). It would be most appropriate for the Master Teacher: the technique permits diagnosis as the basis for prescriptions. It also makes a learning experience out of the assessment process. Thus, the Master Teacher, as examiner, is involved in the study and understanding of intimate cognitive processes, their development, structure, and meaning, and the way in which they merge into the end product. Assessment, then, is also primarily concerned with the learning and training process. Beyond understanding the student's cognitive structure and the changes occurring in the assessment process, the nature of the interaction epitomizes the Anisa theory of teaching which involves guiding the quality of interaction to sustain the release of potential at an optimum rate. The dynamic assessment requires that the examiner create a rapport marked by personal warmth, sincere interest in the success of the examinee, a readiness to communicate feelings of pleasure whenever the examinee succeeds. Feedback and intervention are required to prevent failure and enhance success. The fact that the examiner must interact by assuming the role of teacher-trainer in order to produce the necessary changes in the examinee has a profound effect on the examiner's attitude — his scientific curiosity, clinical orientation and affective involvement. It contrasts dramatically with the objective, neutral, and disinterested manner of administering static conventional tests where the examinee is frequently treated as an object. Since Anisa treats the student as both object and subject, the quality of the interaction required by the dynamic assessment is totally consistent. It is a means — often requiring an appreciable investment on the part of the practictioner — to revealing the often hidden potentialities of individuals and their modifiability. For the Anisa practitioner, it becomes more evident because the release of potential for each individual is the primary goal Feuerstein observes: "The uniqueness of each individual turns his fate into the fate of the world — his world." According to Sages:

> Why was Adam created alone and unique? To teach us that he who brings about the loss of one soul is as if he has annihilated a whole world; while he who saves a soul is as if he has rescued a whole world.
>
> — Talmud Sanhedrin

In addition to its usefulness for the Anisa practitioner, its theory, instruments, and techniques are based on over twenty-five years of empirically based study. Largely influenced by Piaget et al., its theoretical orientation places it within the organismic paradigm. The theory and empirical base are a significant contribution to a testing technology oriented to assessing change in the individual over time. The organismic paradigm identified the problem. Dynamic assessment is a significant step in converting the problem into a puzzle-form that, to a much larger degree, can now be solved. Dynamic assessment provides an excellent theoretical and empirical base for future study of problems consistent with the "normal science" stage of the organismic paradigm. Feuerstein identifies some of these problems: (1) establishing a base line for quantifying modifiability, an index of modifiability, (2) expansion of the test instruments for both individuals and groups, (3) development of techniques for assessing potential modifiability in specific learning disabilities, and (4) clarification of non-intellective factors important to specific and individual levels of modifiability. For those who will be working within the Anisa paradigm, attacking these problems, providing alternatives to conventional psychometric procedures, will not only make a contribution to theory but result in immediate benefits to children.

Criterion-referenced testing. Criterion-referenced testing was introduced in the mid-sixties to provide test-score information for decision-making, giving rise to objectives-based instructional programs. It was felt that norm-referenced tests do not provide the desired kind of test score; they primarily facilitate the comparison of individuals (or groups) with respect to a norm group. Criterion-referenced tests, however, are constructed to permit the interpretation of individual (and group) test scores relative to a set of objectives. They are an alternative to norm-referenced tests designed to meet the measurement requirements in objectives-based instructional programs, competency-based certification, and situations where the performance of an individual relative to a set of competencies is the main concern (Hambleton and Eignor, 1979).

Glaser (1963) and Popham and Husek (1969), who are significant contributors to this field, were interested in referencing examinee test performance to a well defined domain of behaviors measuring an objective. Thus, Popham (1978) provides a definition:

> A criterion-referenced test is used to ascertain an individual's status (referred to as a domain score) with respect to a well-defined behavior domain (p. 4).

With respect to terms in current use, there is some confusion over differences among four kinds of tests — criterion-referenced tests, domain-referenced tests, objectives-referenced tests, and a minimum competency test. There are, however, few significant differences among these tests. Current usage treats all as equivalent to the term, criterion-referenced tests. An important distinction, however, is made between criterion-referenced and norm-referenced tests. Historically, both tests were constructed in the same manner. Recent developments in methodology now make the distinction between criterion-referenced and norm-referenced as significant and unambigious; therefore, it is correct to refer to a test as either criterion-referenced or norm-referenced (Hambleton and Eignor, 1979).

It would be helpful to summarize some of the similarities and differences between norm-referenced tests. The purpose of norm-referenced tests is to facilitate comparison among individuals on the ability being measured whereas criterion-referenced tests assess the individual's level of performance relative to a well-defined behavior domain. With respect to the method of test development, the statistical properties of test item selection are most important for norm-referenced tests. For criterion-referenced tests, domain specifications are prepared and items written to measure the behaviors related to a particular competency. Quantification scales differ with norm-referenced scores anchored to the average level of the group while the anchor points for criterion-referenced scores are at the ends of the scale — 0% and 100%.

It is evident from the use of test scores that this new testing technology helps solve a major problem in implementing the Anisa paradigm. Thus, norm-referenced scores are generally used to make comparisons among students to deal with selection problems (e.g., homogeneous groups for reading and other educational "tracking"). Criterion-referenced scores are used to make descriptive statements about what a student can do. Students are judged on their own merits. They indicate that things learned can be separated into specific competencies. They can also be used to "sort" students as do norm-referenced scores, but they are "quota free", with no limits placed on the number of students receiving a passing score based on mastery or non-mastery of the skills measured. Scores can be used, therefore, to make instructional decisions at the individual level or to evaluate total-program effectiveness.

Since Anisa is a prescriptive theory, it prescribes goals or objectives at individual and program levels. At the individual level, the Master Teacher is concerned with the developing "learning competence" for each potentiality. The theory of teaching involves diagnosing the student's developmental levels as a basis for making a prescription. The Master Teacher then arranges the necessary environments and guides the quality of interactions to accomplish specific instructional objectives. It is within this instructional process that criterion-referenced tests can play an important role. This new technology is most congenial with Anisa practices when compared to the limited and, generally, incompatible role that the norm-referenced technology plays. Criterion-referenced tests can be used for on-going evaluation at two levels — diagnostic and instructional outcomes. The teacher has a testing technology that is responsive to her immediate instructional practices, determining quite specifically, the mastery or non-mastery of skills in a prescribed domain of behavior.

With respect to the use of criterion-referenced tests in program evaluation, they also prove to be more appropriate than norm-referenced tests. Program evaluators raise such questions as, "How much have the six year olds learned from the Anisa learning competency programs?" Use of norm-referenced instruments could be used to answer this question but it would also require additional considerations (e.g., a control group experimental design). A straight forward answer to the question is not possible with norm-referenced instruments because they were designed only to permit comparisons of one individual with another on the ability measured. Reporting is in the form of grade-equivalents, percentile ranks, standard scores, etc. They provide, however, little or no information relative to such questions, as "What can one individual (or learning competency group) do?"

Nevertheless, norm-referenced tests are still the most frequently used educational evaluation; their limitations need to be understood. These will be discussed to demonstrate how criterion-referenced tests can serve as a constructive alternative. First, norm-referenced tests are designed to make comparisons of individual or some norm group. The results are often used for selecting or placing individuals. In order to make meaningful comparisons, there must be variability in individual responses. In selecting test items from a pool, the ones selected are those that maximize test score variability. This variability spreads the examinees over a scale that allows the user to make comparisons of an individual in terms of the group as a whole. The scores do not allow inferences to be made as to what the student knows or does not know. Criterion-referenced tests, on the other hand, are designed to answer such questions with test items selected to evaluate specifically the domain of behaviors the evaluator wants to assess. This points out the second major shortcoming of norm-referenced tests, that is, the mismatch between content covered by the test and the content of the program being evaluated. Hambleton et al. point out that norm-referenced tests are usually based on an amalgamation of objectives of programs from a nationwide sample. It is difficult, therefore, to find a standardized achievement measure where the content covered closely matches the content goals of the program being evaluated.

A third cause for a discrepancy between test content and program objectives is the purpose of norm-referenced test, that is, comparison with some reference group. Again, this is related to selecting test items that contribute to score variability. Items which measure concepts taught by many teachers and answered correctly by students will be eliminated. Achievement tests, therefore, are looking more like intelligence or aptitude tests and are becoming less sensitive to the effects of instruction. As Feuerstein notes, standardized tests are not geared to an educational approach concerned with modifiability. If an instrument is to assess the learning process, its content must be carefully matched to that of the program. Criterion-referenced tests fulfill this requirement more appropriately.

A fourth area of discrepancy between norm-referenced tests and program evalution is related to the degree that the program is innovative. This is particularly true for Anisa which is a most innovative program. The instructional methods and goals of the learning competency program are different from the traditional program. As a consequence, it is an error to judge the effectiveness of such a program by a tool that has been designed to measure something else. It is notable, however, that six years of research data from the field testing of Anisa in the Suffield School System in Connecticut demonstrated that Anisa children achieved significantly ($P > .05$) better than children exposed to the traditional approaches as measured by the Metropolitan Achievement Tests. Criterion-referenced tests, however, are still more appropriate for program evaluation for they can be designed to tap specific program objectives.

After considering the limitations of norm-referenced tests, it is evident that the new testing technology of criterion-referenced testing can serve as a constructive alternative for many Anisa purposes, particularly instructional and program evaluation. This does not mean that we should not use norm-referenced measures but that we should place them in a different perspective that would call for a more limited use.

So far, we have two constructive alternatives to norm-referenced tests — the Learning Potential Assessment Device and criterion-referenced tests — that are immediately available for broadening use in implementing and assessing Anisa practices. However, this is not sufficient; the Anisa paradigm also identifies other measurement problems that require solution. The most pressing problem that needs work is concerned with the need to develop instruments to measure the process curriculum.

Process measures and other instrumentation. The Anisa paradigm has its philosophical roots in Alfred North Whitehead's process philosophy. "The Anisa Model rests upon the premise that the reality of being is in the process of becoming and that becoming is the translation of potentiality into actuality." (Jordan, 1973). This is reflected in the Anisa definition of development, which is the process of translating potentiality into actuality. The translation of psychological potentialities into actuality takes place through the conscious differentiation, integration and generalization of experience which constitutes learning competence. This is effected by the student's guided interactions with the physical, human, and unknown environments. These environments, in part, comprise the content curriculum which can be assessed using criterion-referenced measures. The Anisa curriculum, however, also includes all the psychological processes which must be mastered in the development of learning competence. These have been organized into five categories: psychomotor, perceptual, cognitive, affective and volitional. The five categories comprise the process curriculum, in part. The Anisa Model's major student outcome is the development of learning competence. Learning competence is effected by mastering the psychological processes in the process curriculum.

During the initial field testing of Anisa in Suffield, Connecticut in 1973-74, Hambleton et al. constructed or selected tests to measure five of the processes that underlie learning competence. These processes were classification, seriation, verticality, attention, and figure-ground perception. Classification and seriation are related to the cognitive category of psychological potentiality while the remaining processes belong to the psychomotor, volitional, and perceptual categories, respectively. Instruments were also constructed to measure a higher-order specification, cooperation, an aspect of moral competence.

Hambleton, Algina, Bourque, and Larrivee (1974) from the Laboratory of Psychometric and Evaluative Research, University of Massachusetts worked, in collaboration with the Anisa staff, on the development of these measures. They conducted a review of the literature pertaining to measurement of processes, collected available instruments, and constructed or selected instruments that measured these processes. These instruments were developed and administered to Anisa students and a control group. The results of these efforts provided the first empirical data for test construction, administration, and use in implementing the Anisa practices in the field. The results were encouraging, providing evaluative data on the Anisa program that indicated students developed learning competency skills that were equal to or better than their counterparts in a neighboring school. The tests were constructed and administered without the advantage of elaborate validation procedures. Nevertheless, significant experience and initial data were obtained in this important area. The development of tests for seven of the processes underlying learning competence was a beginning; there are many more processes posited by the model. Some of the processes such as classification and seriation have already stimulated a large amount of research along the lines well documented by Inhelder and Piaget (1964). These research data permit specification of these aspects in behavioral terms which provide information about the development of the child. Other processes such as attention and verticality, however, do not have a substantial research base. Consequently, these will require a program of basic research concerning the development of each process. The results of this strategy will not be immediate; a great deal of mopping-up work is still required in this "normal science" phase of paradigm growth.

Since the Anisa Model deals with the student as both object and subject, the use of the participant-observer is a legitimate source of data in evaluation studies. A variety of observer rating scales for systematic data gathering can be tailor-made. Hambleton et al. (1974), for example, developed the following instruments for Project Anisa-Suffield: Learning Environment Staff Perception Index (LESPI), Learner Perception Interview Schedule (LPIS), and Learning Environment Observer Rating Schedule (LEORS). Questionnaires, coupled with process observers, are also effective means for obtaining data to provide systematic feedback to staff and students. The video taping of staff and students has been effective in implementing Anisa in Suffield and the Cooperative Special Services Center in Connecticut. Within the participant-observer, operations-research framework, a variety of tailor-made instrumentation is possible.

Computer technology is highly desirable to assist the Master Anisa Teacher in diagnosing the developmental level of each student for each category of psychological potentiality. Project Anisa-Suffield initially developed teacher-observation schedules for recording, storing, and retrieving information on each child. While this can be performed manually, it is very cumbersome. This process, however, does not preclude the implementation of the Model, but it limits its overall effectiveness. Therefore, the use of computer technology is very necessary for efficient operation. This is technically and operationally feasible at this time. A prototypical system was created for implementing Project Anisa-Suffield but not put into operation because of limited funds.

A vitally important area — but one largely untapped at this time — is the identification and measurement of cognitive processes in the brain. The paradigm clearly identifies the problem and sets the stage for a great deal of creative work. Parallels with the physical sciences, as discussed in Chapter II, suggest the lengths to which scientists will go in developing instrumentation if the paradigm poses the puzzle (e.g., radiotelescopes, scintillation counter to identify the neutrino, etc.). The Sperry et al. (1977) studies on the split brain are efforts in this direction whose findings are immediately useful in diagnosing learning disabilities. Pribram's (1979) work suggesting that the brain functions like a holograph also provides interesting new leads. A creative multidisciplinary approach is most probable if this important area is to be developed.

CHAPTER VII

METHODLOGICAL IMPLICATIONS

Methodology versus Method

Having discussed the problems of concepts and instrumentation in the "normal science" stage of paradigm growth, methodological problems will now be addressed. As a context for addressing these problems, it will be helpful to clarify some terms within the theory of Logical Types. Many things can be expressed in a language, except statements referring to that language itself. To talk about a language, we need a metalanguage for the expression of its structure. For example, the term "method" denotes a scientific procedure; it determines the rules and steps which must be followed to achieve a given end. Methodology, in contrast, is a concept of the variety of methods which can be used in different paradigms or scientific disciplines. It is concerned with the activity of acquiring knowledge generally and not with a particular investigation. It is a "metamethod" and stands in the same logical relation to method as a class to one of its members (Watzlawick et al., 1974). Every effort will be made to avoid confusing method with methodology and the philosophical difficulties that result.

The key to the growth of a new paradigm is in doing something constructive about its concern with the activities of acquiring knowledge — in essence, methodological problems. My thesis rests on the methodological base that the growth of scientific knowledge follows

Kuhn's framework of paradigm development. Since Anisa represents a shift from the mechanistic to an organismic paradigm, the methodological problems will be viewed within this perspective. Related methodological problems (e.g. self-referencing problems — strange loops — in explaining itself, Piaget's epistomology, and Ossorio's concern for putting the person into scientific method) are considered within the paradigm perspective.

Within this methodological framework, therefore, specific methods that have been or need to be developed will be the focus of this presentation. With respect to the former, while it may be redundant, it is necessary to state that many of the methods developed under the mechanistic paradigm remain appropriate for limited problems. Their emphasis on rigor has provided experiments that are elegant in design but frequently limited in scope and relevance. These methods, applicable to the behavioral sciences, have been clearly explicated by Campbell and Stanley (1966) in their work Experimental and Quasi-Experimental Designs for Research. These represent the legitimate methods — the "true" experimental designs — accepted by the community of mechanistic scientists. My concern, however, is for the creation of new methods — new rules and procedures for puzzle-solution — identified by the Anisa paradigm.

Field Testing the Anisa Model: Research Strategies

This task will be approached by first presenting the research methods that were used in the initial field testing of the Anisa paradigm in Connecticut from 1973-1980. First, as Director of Research and Principal Investigator of Project Anisa-Suffield and Project Inspire, I shall present the experimental designs employed. Second, transcending this empirical base, new methods will be explored consistent with the Anisa paradigm. Seminal work in this area by Bronfenbrenner and Bateson will be a primary source for developing new methods that have implications for the Anisa theory of evaluation.

Transforming experiment. Bronfenbrenner (1977) quotes Professor A. N. Leontiev of the University of Moscow concerning differences in assumption underlying research in human development in the Soviet Union and the United States:

> It seems to me that American researchers are constantly seeking to explain how the child came to be what he is; we in the U.S.S.R. are striving to discover not how the child came to be what he is, but how he can become what he not yet is (p. 528).

Soviet psychologists have created what are "transforming experiments" which radically restructure the environment, producing new configurations that actuate previously unrealized behavioral potentials of the subject. While they have been successful in designing clever experiments, once they move out of the laboratory the "transforming experiment" degenerates into a demonstration of prescribed ideological processes. The central issue, however, is that "transforming experiments" are rare in American research on human development. Most "scientific" efforts into social reality perpetuate the status quo. The mechanistic world view largely determines this approach which is reflected in even treating sociological systems as givens rather than as evolving and susceptible to novel transformations. There is a reluctance to experiment with new social forms for realizing human potential.

Bronfenbrenner (1977) presents his most demanding proposition from his "Toward an Experimental Ecology of Human Development" which defines the nature and scope of ecological experiments:

> Research on the ecology of human development should include experiments involving the innovative restructuring of prevailing ecological systems in ways that depart from existing institutional ideologies and structures by redefining goals, roles, and activities and providing interconnections between systems previously isolated from each other(p. 528).

Despite their scarcity in the published literature, some examples of transforming experiments can be cited: changes in hospital practice of allowing mothers to have immediate contact with newborn infants and the removal of retarded children from orphanages and placement in the care of retarded adult females in a hospital ward. In contrast to these relatively narrow experiments, the Anisa paradigm represents an ecological innovation for American society that could be carried out within the framework of a systematic research design. Such a design would epitomize Bronfenbrenner's most demanding proposition concerning research on the ecology of human development. It has the potential of being a "transforming experiment" par excellence.

Leontiev's concern for the child, "...how he can become what he not yet is." is consistent with Anisa as a prescriptive theory concerned with the future (transcendence). Anisa, however, maintains a dynamic balance between immanence and transcendence. Thus, immanence is analogous to the mechanistic concerns for "what is", while transcendence is concerned with "what might" to be. Another way of stating this relationship is that means-ends are hypenated and cannot be treated as entities. It would, therefore, be desirable in understanding the new directions that the Anisa theory of evaluation may take by presenting the research designs that were initially used in field testing the Model at several sites.

Since the Anisa paradigm represents a comprehensive educational system functionally defined by specifications, it presents an ideal basis for a research design that can be deduced from theory. This strategy, analogous to the design of new cities, is actively being considered. The search for significant funds — literally millions of dollars — continues to be a focus of effort. This would approximate the ideal example of Bronfenbrenner's proposition for on the American educational scene there is no other "transforming experiment" with a scientific underpinning as elegant as Anisa. This is a bold claim, but such a grand experiment now appears as feasible as a trip to the moon. The cost/benefit factors to mankind may be significantly greater.

The second strategy of introducing Anisa practices into existing school system(s), however, is the more probable approach for initially implementing Anisa. In fact, once the theoretical structure was sufficiently formalized, it was introduced as several school sites in 1973 — Hampden, Maine and Suffield, Connecticut. It is notable that these two strategies are not mutually exclusive for there is a reciprocal relationship between them. The positive empirical data from the less than ideal research conditions of field testing in existing systems are creating the basis for the more probable realization of the first strategy (search for large funds).

Initial research designs. After fourteen years of theory building, the first efforts in 1972 of moving out of "theoretical hunch-land" into the "land of verification" were launched in field-testing the Anisa Model. Following the second strategy, Anisa was introduced into the Suffield Public Schools, Connecticut. The intervention began with the nursery and kindergarten levels with a programmatic design of rolling up by levels; thus, in 1980 Anisa has been systematically expanded from Grades K-7.

As Director of Research for Project Anisa-Suffield (1973), I had the responsibility for developing the evaluation design. Since the Anisa theory defines "evaluation in terms of the purpose of the activity or program being evaluated" (Jordan, 1973), a goal evaluation model emphasizing operations research within a general systems approach was used (Suchman, 1967). Anisa, as a prescriptive theory, also seeks "to relate means to ends, distinguishing efficient from final causes." Thus, the initial research design exemplified these two critical Anisa concepts of evaluation.

Project goals, specified by theory, were established and evaluated by the degree to which they were achieved. Both formative and summative methods were used. Each goal was evaluated using the following criteria: (1) effort; (2) effect; (3) impact; (4) efficiency; and (5) process. Measures of effort involved numbers of staff and training sessions, students served, meetings held, etc. The operations research approach separates measures of effort from effect. These measures are important not only for the on-going operations but for dissemination and replication purposes. Replication, as a method, will play an important role in establishing the reliability of previous findings of Anisa practices (Kratochwill, 1979). While not as simple as "intrasubject replication designs" of operant conditioning in various settings (Kazdin, 1978), this method should be employed. It is notable that Project Anisa-Suffield was identified and validated by the Department of Health Education and Welfare (1976) as an exemplary program recommended for wider dissemination.

With the wider dissemination of Anisa, the research method of "secondary evaluation" should be considered (Cook, 1973). This would involve the systematic re-evaluation of the data reported in each of the primary evaluations from each Anisa field-site. Secondary evaluations re-examine the conclusions drawn by the primary evaluators to determine, in fact, if they can be substantiated. For example, the Coleman Report was critiqued by Bowles and Levin, and Cain and Watts with the data reanalyzed by a Harvard group and published in a volume edited by Mosteller and Moynihan. The primary evaluations from the field testing of Anisa in Suffield and the Cooperative Special Services Center, Connecticut, Hamden, Maine and Ohio Valley Regional Development Commission suggest the feasibility of this method in the near future which would add to the growing body of empirical data supporting the Anisa paradigm.

Each major goal was also evaluated by measures of effect. The effect of the programs on the various systems, that is, individual, group, school, and total system were obtained using varied instrumentation and research methods. A variety of instruments was used: questionnaires; semantic differential; observation schedules; process measures; and standardized tests. The research methods involved a static group comparison design (Campbell and Stanley, 1966), comparing students exposed to the Anisa program with a control group in another community, using instruments to measure the process curriculum. The results varied on some of the measures with Anisa students doing slightly better than the controls.

Another research method used to evaluate the effects of the Learning Competency Programs on the content curriculum involved in matched (age, sex, intelligence) control group design using the norm-referenced Metropolitan Achievement Tests (Bondra, 1977). It was hypothesized that students who participated in the Anisa Learning Compentency Program would achieve as well as students in the traditional program. Measurements taken over a six year period demonstrate that Anisa students at the kindergarten level achieve reading skills significantly (P>.05) better than students in the traditional program. The results were the same for the six- and eight-year-olds. Based on the results of this six-year longitudinal study, all of the Anisa students from Grades K-4 did as well as or significantly better than students exposed to the traditional program.

The purpose for detailing these specific research findings is to illustrate the integral relationship between the Anisa theories of evaluation and administration. The evaluator and chief administrator were fully aware that the matched control group method was an inappropriate (mechanistic) design using inappropriate norm-referenced achievement measures for evaluating the content curriculum of the Learning Competency Program. With respect to instruments, for example, criterion-referenced tests would have been more appropriate. Instead of a cross-sectional research design, it would have been more appropriate to have a longitudinal design involving growth in the same students. These factors would have provided a more realistic evaluation of the effects of the Anisa practices. Nevertheless, the effort and funds for this "legitimate" (mechanistic) scientific method of matched control group were made more for administrative and political reasons than scientific purposes.

The evaluator and administration were not deceiving themselves that this method served to provide the relevant hard data regarding the effectiveness of the Anisa theory and practices; it did not measure the complexity of reciprocal causality. Rather, it provided "scientifically" acceptable data to the decision-makers of their own professional integrity and responsibility to students, parents, and community; and further, that the introduction of the new, innovative program would not harm the students. That is, the responsible decision-makers would have "hard data" for themselves and their constituency that, in accepting the new program, the students would at least do as well as or better than the program that was being replaced. If the results had shown that the students did not achieve as well on this one criterion, the administration may, nevertheless, have decided to continue if data from other more valued outcomes justified continuation. This illustrates the integral relationship of evaluation design providing relevant data for administrative decision making; there is a reciprocal relationship between the two.

This relationship was not initially appreciated in the Suffield operation. For example, under the pressure of using available funds to provide services for children, monies were diverted from evaluation (dropping the process measures and the "friendly critics" role of Harvard University). The administration later acknowledged the error which proved to be costly in reduced effectiveness and program acceptance (Lincoln, 1977). It is notable, again, that the use of the "hard methodologies" of mechanistic science can serve an important, although more limited, role when used in the larger circular, causal, and feedback processes of hierarchic structures of the organismic paradigm.

Measures, therefore, were obtained on the effects of the programs on the different systems involved (individual students, Learning Competency Program for different age level groups, and individual schools). All of these sub-systems, however, were within the total Suffield school system. As part of the research design, it was desirable for the decision-makers not to be blinded by their own wishes and selective attention to data from within the system only; therefore, efficiency factors of the innovation were addressed. It was very helpful for the key decision makers to have knowledge regarding the efficiency of the Anisa Model by comparing it to other available educational models on such factors as cost effectiveness and internal consistency (data language, assumptions, and testable hypothesis, etc.). This broader perspective would permit more intelligent decision-making by the administration by minimizing within system (e.g. Hawthorne effect, ego involvement of participants, University bias, and other blind spots of the research design and Director of Research).

The method used to address these factors involved engaging an independent university to provide experts who would serve as "friendly critics." Dr. Robert Anderson, Professor, Harvard Graduate School of Education served as senior consultant. He was assisted by Dr. Joan Bissel, Assistant Professor, Harvard, and graduate assistants. They used such means as review of the Anisa literature, interviews, on-site observations of classrooms, etc. Dr. Bissel et al. (1975) states, "...there is no question that Anisa offers unique attributes as an educational approach. Its attempt to deal with organizational and administrative aspects of schools as well as aspects of classroom methods on curriculum is extremely unique. Few other approaches to early education are as broad in scope as is Anisa." (p. 1.6). They further state:

> In conclusion, Anisa possesses all the elements traditionally found in a scientific or educational theory. It has a number of explicit assumptions, most of which provide an extremely idealistic basis for educational planning. It has a comprehensive and straightforward set of definitions of key educational concepts. These definitions are broad enough to be used in a wide range of educational settings. Finally, Anisa specifies numerous testable hypotheses concerning relationships between experiences in the model and student growth. It is because of these fundamental elements of an adequate theory is found in Anisa that it can provide the basis for Suffield's educational planning and practice. Because of the abstract and general nature of the theory, specific applications in classroom situations will have to be derived by Suffield staff as the model is implemented. What is perhaps most important is the fact that Anisa provides a highly flexible theoretical umbrella which can be modified as necessary during the process of implementation. ...We find that Anisa provides a strong framework for Suffield's making decisions about organization, staffing, institutional renewal and related issues of educational administration (p. 1.7).

It was helpful, as part of the research design, to engage an independent and prestigious university to provide a wider perspective on the Anisa Model for the staff and the lay community. While their conclusions were primarily positive, this operations research method provided a before the fact, built-in, self-corrective approach that made the findings relevant and credible not only for the local but the broader educational community.

With respect to measures of process, the research design took into account the fact that many innovative programs activate individual, group and institutional behaviors which prevent evaluation and adoption of the program on its own merits. The literature suggests that the educational scene is littered with the skeletons of innovations which collapsed due to inadequate attention to the totality of change processes. Therefore, the evaluation design had as its second major goal the demonstration of the application of a process model of planned change.

A descriptive history of the development, growth — successes and failures — was undertaken as part of a doctoral dissertation by Richard Lincoln, A Case Study of the Implementation of the Anisa Model of Education in Suffield Public Schools, Connecticut, 1978. His study used Havelock as the framework for evaluating the change process. The systematic use of doctoral students as process observers from the University of Massachusetts who worked with the administrative and teacher teams proved very helpful in implementing the Model. Richard Lincoln, who also served as Project Director, was a participant-observer intimately involved in all administrative decisions. Using the systematic feedback from other process observers and the operations research design of the Project permitted evaluation as an on-going process of every aspect of the program — both process and product. The built-in process of immediate feedback allowed for necessary modifications of program and the research design itself — an organic process.

Although the true objectivity of the mechanistic paradigm was not a goal, the role of the University dissertation committee, coupled with a specified theoretical framework, enhanced the reliability and validity of Lincoln's case study based upon participant observation. It is notable that the case study and participant-observation methods have greater legitimacy and relevance under the organismic paradigm.

Conceptual and experiential basis for paradigm perspective. As Director of Research, with a key role on the Leadership Team, my understanding of the Anisa Model, at that point in time, was influenced by the following theoretical concepts regarding change strategies. The disciplinary matrix of these concepts — now seen as consistent with the organismic paradigm — were used as the basis of new ideas that differed from the mechanistic view of what constituted an acceptable research design. My first-hand experience in field testing the Anisa Model provided an empirical data base from which new ideas evolved. At that point in time, attempts were made at reconciling theory differences; these were generally unsuccessful or presented defensively. The attempted resolution of some of these problems led to the formulation of this dissertation. One consequence of this study was to clarify the futility of those efforts. The awareness has now emerged that Anisa offers a gestalt shift — a new world view — representing a new paradigm which permits the reframing of the theoretical differences as within theory but not between paradigm differences. The paradigm concept has allowed me to sort out more clearly theoretical and methodological issues vis a vis the paradigm under which they are subsumed. Mechanistic research designs, therefore, dominated thinking and were largely influenced by grant proposal requirements for Federal funding. Thus, launching a major social change effort in the school system, which was to be "scientifically" evaluated, posed significant theoretical and methodological problems.

Again, at that time, my thinking was largely influenced by the convergence of Anisa theories with a number of existing conceptual schemes (e.g. General Systems Thoery and personality theories with their related concepts of change for the individual, group, and organization). With respect to General Systems Theory, with its fountainhead resting upon cybernetics, information, and communications theories, the basic shift in assumption from entropy to negative entropy provided a new view of change. The concept of entropy, as defined in the Second Law of Thermodynamics, was true in closed, physical systems of thing-thing interaction. There was evidence, however, that this law did not apply in bio-psycho-social systems. For these systems, rather than assuming a disorganized complexity or a closed system where entropy is ultimately operative, an organized and dynamic complexity was assumed; the concept of negative entropy was thought to be operative. It assumed an open system wherein there was a process that tends toward greater integration and organization. Negative entropy assumes an organized complexity allowing for an open system that permits the "emergence of originals" — a theory of improbability with the ultimate prediciton of one change in infinity.

The conception of psychological entropy as a degradation of energy and negative entropy as a release of psychological energy had great power and scope. It showed the functional relationship that exists between organism-organism, organism-thing, and thing-thing interaction. It holds for all ages and can be applied to varied cultures. The system allowed for measurement in quantitative terms. Normative statistics, applied to the assumption of a disorganized complexity, could be useful in special cases. The need for new mathematical models which operate on the assumption of an organized complexity were in the process of development (e.g. ipsative and nonparametric statistics). Negative entropy, or degree of organization, could best be conceptually mapped in such new mathematical terms.

There was considerable difficulty in the communication of the meaning of terms; for example, one of the major paradoxes debated was the relationship between "information content" and "physical entropy." The former could only be a special case of the latter, and there was no necessary relationship between statistical entropy and physical entropy. Within limits, however, these terms were treated as equivalent and allowed translation from thermodynamics to the theory of computing machines from brain models to social organization. In the physical world of thing-thing interaction, these theories demonstrated their usefulness and created a technological revolution with concomitant implications for social change. At the physical level the bridge from theory to practice was well girded.

Whether the pattern of "entropy" was the universal process with "negative entropy" a temporary interlude as Toynbee's system would suggest, or whether the concept of "negative entrophy" was the basic one that always tends toward higher levels of integration and organization was the central issue (Bateson now integrates these two processes, see page 184). The framework, however, treated the individual personality as no longer self-contained but open to the world about him. He could be treated as an open system in an open society. The circular, causal, and feedback process — self-corrective basis of such a system — offered humility, but its optimism offered much hope and faith — qualities of ideology.

It was still difficult to establish isomorphic relationships between the assumptions of the Anisa Model and General Systems Theory. While there were semantic issues involved, the areas in which the two theories converged in describing and understanding processes in the real world were far greater than areas of divergence. The concept of translating potentiality into actuality — a process involving purpose and based on subjective aim, tending toward higher levels of integration and organization. Just as some have viewed cybernetics as a conceptual breakthough that gave rise to the "second industrial revolution", the Anisa assumption regarding final cause and subjective aim appears to this author to have given rise to a conceptual revolution with equivalent impact on educational practice.

In establishing linkage with the Anisa Model and other conceptual models of personality and organization, there was an impressive convergence in meaning when comparing their underlying assumptions concerning the nature of man. It was again notable that there was virtually a Tower of Babel when comparing theoretical models because of the theory builder's need to develop his own language and meanings. The underlying structures — physical or behavioral — were frequently present and observable but differences resulted in the way in which they were symbolically represented. Nevertheless, there were commonalities among a variety of theorists who arrived at similar assumptions about the nature of man. For example, Harry Stack Sullivan's (1953) interpersonal theory of psychiatry, based on participant clinical observations, operated on the explicit assumption that the tendency toward health is greater than that toward disease. Carl Rogers (1959), in his client-centered therapy, assumed that the individual has inherent in him the necessary forces for self-realization. Allport (1937) and, most notable, Maslow (1954) — as a positive third force in psychology — operated on a similar assumption. Karl Menninger (1963) developed a major theoretical system and consequent clinical application based on an equivalent assumption.

As a behavioral scientist, Harold Anderson (1957) was most lucid in using such assumptions when applied to personality and social growth. His propositions were supposedly valid at physiological, psychological, and social levels. For the circular, causal, and feedback relationships that exist between the organism and environment, Anderson stated that there were two processes: (1) the "growth circle" and (2) the "vicious circle" (comparable to Hersey and Blanchard's (1972) high expectation-low expectation cycle). The concept of self-stimulation, or feedback, was extended to include the circular behavior that exists in the interaction of human beings. The growth circle, or socially integrative behavior, he stated, manifest high degrees of three qualities: spontaneity and harmony, differentiation and integration, self-expression and the expenditure of energy with others in a common purpose. Problem-solving in social conflict was not a psychology of adjustment, but a psychology of invention. In the circular process of interacting and working together, the emergence of originals represented an integration of differences. The free interaction of minds-in-disagreement was creative. This was not viewed as a mechanistic stimulus-response sequence but as a process; the response was not just to stimulus or challenge but a response to relating. Circular behavior was creative, inventive; resulting in the term "growth circle." Consistent with the basic assumption, the dynamic, circular behavior was in the direction of growth or health. Thus, Anderson presented a major hypothesis: socially integrative behavior in one person, group or organization tends to induce socially integrative behavior in others.

Anderson's vicious circle, on the other hand, consisted of behavior wherein individuals cannot integrate their activities in a creative direction. Domination, the use of power over others, was the central characteristic. Thus, Anderson's major hypothesis for his second process was: domination in one person, group or organization tends to incite domination (resistance) in others. Resistance, as a consequence of domination, manifested itself in such behaviors as: submission, aggression, frustration, rigidity, compensation, etc. These were negative terms and generally applied to interpersonal conflict in situations of stress. A content analysis of most psychological literature would indicate a greater number of references to aspects related to the vicious circle. This was typical of the Freudian and many other clinical approaches. The implications of this framework, however, would change the emphasis. The vicious circle — psychopathology and social pathology (the suppression of potentiality) — were viewed as special cases within a larger, more positive process that tended toward higher levels of growth, health, organization, or self-renewal.

The vicious circle could be cut by the intervention of a socially integrated person, group, or organization. Psychotherapeutic intervention was basically a socially integrative relationship; most psychologists regarded it as a speeded-up and assisted growth process. Therapy releases the person for more rapid development of spontaneity, integration, and self-realization. These same principles, therefore, were operative at the organizational level — only the strategies of intervention differed.

Social psychological theory and research, whose units of study were organism-organism interaction (e.g.,dyad, group, organization, etc.), gave rise to theories based upon similar assumptions about the nature of man and their implications for social organization. With respect to the application of such theories to formal organizations, Chris Argyris (1976), Frederick Herzberg (1966), Hersey and Blanchard

(1972), Rensis Likert (1967), Douglas McGregor (1960) and others had programs in operation or were influencing organizational development that promoted human growth and organizational self-renewal. When applied, their theories provided evidence that greater individual self-realization and organizational effectiveness was generated. They offered the basis of a theory of self-determination, but also an approach to a theory of renewed growth.

Since the Anisa Model, with respect to change, is primarily evolutionary, the basic strategy to bring about social change could be characterized as planned change (Lippitt et al. 1958). This was in contrast to change strategies involving revolutions or social reforms (See Appendix A). Toynbee's hyperexis (civilizations follow a pattern of three and a half beats); Marx's historicism; Plato's steady state, etc. were different approaches to understanding change. Anisa appeared to have similarities to John Gardner's (1963, p.5) concept of social change. He indicated that the classic question of social reform has been, "How can we cure this or that specifiable ill?" He stated that we must now ask another kind of question: "How can we design a system that will continuously reform (i.e., renew itself) beginning with presently specifiable ills and moving on to ills that we cannot now foresee?" This suggested, therefore, that the basic assumptions about the nature of man when extended to psychological and social systems, offered a theoretical basis for asking and attempting to answer John Gardner's question. It was possible to bridge from theory to practice and create a system that provided for its own continuous renewal — for the individual and organization. It was notable, however, to add Gardner's caveat, "Knowledge will be a sane weapon only if it is linked to a deeply rooted conviction that organizations are made for men and not men for organizations." (1963, p.64)

In retrospect, these theories were part of a disciplinary matrix consistent with the organismic paradigm. At that time, the Anisa Model was not viewed as a paradigm, but it was beginning to give conceptual order to diverse theories characteristic of Kuhn's pre-paradigm stage of development. Eventually, Anisa emerged as a paradigm with its presupposition concerning the nature of reality. The Anisa theories are deduced from this first principle with each theory an integral part of a comprehensive and coherent whole. As an emerging new paradigm, the entire structure rests on the key role of the theory of evaluation. There is, in turn, an integral relationship between the theory of evaluation and the theory of administration, the latter orchestrating the entire hierarchic structure based on feedback from the evaluation design. It is beyond the scope of this study to delimit further this relationship but merely to point out its importance.

Administration and research strategies: integral systems. The integral relationship between the Anisa theories of administration and evaluation emerged very prominently in the Project Anisa-Suffield experience. The Director of Research played an important leadership role. The change strategy (i.e. planned change using a goal evaluation, operations-research design) was a key factor to be considered by the Superintendent of Schools and the Board of Education in their decision to implement the Anisa Model in Suffield. It became even more salient when I became the Principal Investigator (i.e., Superintendent of Schools) for Project Inspire (1978). This Project, the result of planned change was to implement the Anisa Model, with an initial focus on special education students, in the Cooperative Special Services Center (CSSC) comprising five school systems in Connecticut: East Granby, East Windsor, Granby, Suffield and Windsor Locks. Project Inspire is supported by $500,000 of Federal Title IV-C and local funds for a three-year period from 1978-1981. It is one of the "ripple effects" of Project Anisa-Suffield and can be viewed as another field-testing site for the Anisa Model. As the chief administrator, responsible to the Board of Education and the communities, recommending a major change in organizational goals represented a significant leadership action. Since planning was based upon Anisa theory, the key theoretical concept states that purpose generates structure which then serves as a guide to action. The administration of an Anisa educational system, therefore, serves the primary purpose of actualizing the potentialities of human beings. Since man has an infinitude of potentiality, the primary goal of the organization is the release of human potential — for each student and the collective potential of the organization (Walker, 1975). To accomplish this, the leadership needs to articulate a clear vision of where the organization is going. While the final end-state in education is frequently not clear, the direction can always be indicated.

Administration, in Anisa terms, means to serve. In accomplishing this service function, there is a dynamic equilibrium between leadership (change) and management (stability). Thus, it was a major leadership function for me to recommend to the Board of Education that we change our existing goals and move in the new direction of implementing the Anisa Model as the primary organizational goal. Central to the Board adopting this goal in 1977, was the explicit change strategy of Anisa theory, i.e., leadership arises out of immanence — man's capacity to use accumulated experience to negotiate the present with an eye toward the future — to what he may want to become (transcendence).

Four factors in the organizational history (its immanence) helped to facilitate the Board's approval for implementing the Anisa Model. First, the CSSC organization was created and developed, based on a strategy of planned change. Second, the Anisa theory of administration made explicit and operationally useful a management system based on Situational Leadership developed by Hersey and Blanchard (1972). There is essential congruence on all major concepts — particularly the nature of man — between Anisa principle and Situational Leadership Theory. The latter is an integration of current theories of administration which serves as a synthesizing framework, emphasizing compatabilities rather than differences. Situational Leadership established a positive integrating relationship among Maslow's hierarchy of needs, Herzberg's motivation-hygiene theory, Argysis' immaturity-maturity continuum, McGregor's Theory X and Theory Y, Likert's management systems, Blake's two-dimensional leadership grid, and the Ohio State behavioral categories of "Initiating Structure and Consideration." Situational Leadership is further based on a curvilinear relationship between initiating structure and consideration behavior of a leader and the task maturity level of the follower(s). The theory, therefore, provides the teacher, administrator, and the parent with some understanding of the relationship between an effective style of teaching, administering, or parenting and the task maturity level of his students, staff, or children. This theory made explicit many of the assumptions and practices that were being used. It, therefore, facilitated the adoption of this new direction by the Board.

The third factor that facilitated the change effort was the relatively successful implementation of the Anisa Model in Suffield. The fact that the Project Anisa-Suffield was a validated Project by the Department of Health, Education, and Welfare, largely based on the results of the evaluation design, also influenced the decision-makers. The fourth factor — in many ways the most important — was the organizational experience of basing professional practices on a substantive body of theoretical knowledge. In collaboration with staff from the cooperating systems and Federal Title III funding, their current practices were based on the 3R Model (an ecectic model based on the learning theory of B. F. Skinner, ecological theories of Nicholas Hobbs and William Rhodes, Reality Therapy of William Glasser, and rational emotive therapy of Albert Ellis). The 3R Program, also a nationally validated Project by HEW in 1972, served as the theoretical basis for diagnostic and special education practices in the cooperating five towns. Thus, the organizational history, with the Board of Education basing its professional practices on scientific theory, facilitated the acceptance of the Anisa Model which was readily seen as a much more elegant theory than the 3R Model. Being a comprehensive and coherent scientific theory of education and integrated with a theory of administration, the Anisa Model more adequately fulfilled the administration's expectations.

These first-hand experiences with testing Anisa theory in the "land of verification" have added to its accumulated history. Some of the research methods that were successfully used can now be transcended as we explore the implications that are indicated by the Anisa paradigm. Transcending the fourth factor discussed above, i.e., the willingness of the educational community to base its professional practices on a scientific theory, has led to the possibility of using even more sophisticated research methods in future undertakings.

Experimental Ecology of Human Development

Given the key role of the Anisa theory of development, it is entirely appropriate that evaluation should also emphasize its importance.

Chapter III discussed certain limitations of the mechanistic approaches to research on human development. Bronfenbrenner (1977) also observes that the emphasis on rigor has led to experiments that are elegantly designed but frequently limited in scope. Many of these experiments involve unfamiliar, artificial situations that are short-lived, dealing with unusual behaviors that are difficult to generalize to other settings. He further states:

> ...it can be said that much of contemporary developmental psychology is the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time (p. 513).

Bronfenbrenner notes that the reaction to these limitations has resulted in concerns for the social relevance of research, often with open rejection of the rigor of the "hard methodologies." One major foundation, for example, will make grants only to persons who are victims of social injustice. Less radical approaches involve reliance on existential experience which takes the place of observation; analysis gives way to the direct "understanding" gained through intimate involvement in the field situation. Bronfenbrenner's orientation rejects both the implied dichotomy between rigor and relevance and the assumed incompatibility between research in naturalistic situations and the applicability of structured experiments. He proposes "...an expansion and then a convergence of both the naturalistic and experimental approaches — an expansion and convergence in the theoretical conceptions of the environment that underlie each of them (p. 514)."

He resolves this by using the perspective of the evolving science of the ecology of human development.

Jordan, it is my thesis, resolves these issues by viewing them as paradigm differences. Bronfenbrenner's science of the ecology of human development, nevertheless, falls within a disciplinary matrix that is consistent with the organismic paradigm. His work, therefore, has implications for new methods — puzzle-forms with new rules and procedures for solving them — subsumed under the organismic methodology. While the paradigm perspective is more comprehensive, much of Bronfenbrenner's work is most congenial to the Anisa theory of evaluation and offers possible solutions to methodological problems raised by the Anisa paradigm. Some of these new methods are directly applicable; they can serve as a framework for those implementing the Anisa Model. It is within this framework that we can design a "transforming experiment." While some differences do exist between Bronfenbrenner and Jordan, the areas of convergence far outweigh the differences. Thus, Bronfenbrenner appears to make a contribution to the "normal science" stage of Anisa development.

It is beyond the scope of this work to delimit fully his approach, however, some of his definitions and propositions will illustrate the areas of convergence and their implications for the Anisa theory of evaluation. For example, Bronfenbrenner (1977) provides some basic definitions of the ecology of human development:

> First, the ecology of human development is the scientific study of the progressive, mutual accomodation, throughout the life span, between a growing human organism and the changing immediate environments in which it lives, as this process is affected by relations obtaining within and between these immediate settings, as well as the larger social contexts, both formal and informal, in which the settings are embedded (p. 514).

This concept of environment more closely approximates the four Anisa environments and is considerably broader than that found in psychology in general. Second, he defines the ecological environment topologically as a nested arrangement of structures, each contained within the nest. He characterizes these successive levels in the following systems terms: (1)microsystems,(2) mesosystem,(3) exosystem, and(4) macrosystem. A microsystem, for example, is defined as "...the complex of relations between the developing person and environment in an immediate setting containing that person (e.g. home, school, workplace, etc.) (p. 514)." In somewhat different terms, these parallel the systems approach use in the Project Anisa-Suffield design.

The third definition is concerned with ecological validity which "...refers to the extent to which the environment experienced by the subjects in a scientific investigation has the properties it is supposed or assumed to have by the investigation (p. 516.)" The most signficant factor in this definition concerns the perceived aspects of the environment by the research subjects (their subjective aims) and not merely the objective properties. Bronfenbrenner quotes W. I. Thomas' dictum: "If men define situations as real, they are real in their consequence (p. 516)." This concept has broad application in the behavioral sciences, and it is particularly congenial with the Anisa concept of subjective aim. The second notable factor in this definition concerns the research setting itself. The laboratory may be the valid setting for a given problem while a real-life environment may be valid for a different problem. For example, it has been demonstrated that parent-child activity studied in the laboratory is systematically different than those in the home. In general, research findings obtained in a laboratory setting should not prima facie be interpreted as superior to evidence obtained in a real-life setting. The ecological contexts of the laboratory and real-life settings have their special properties in relation to the specific research question. Since many of the Anisa developmental concepts are based upon empirical studies, the application of these in field-testing may produce different results. Before discarding or revising the initial concepts, the ecological contexts of the findings should be explored. This is an important caution for Anisa practitioners. It is equally important to take this factor into account before revising theory for it may involve more than the inappropriate implementation of techniques by the staff.

In any scientific undertaking, decisions on the research design are determined by theory (paradigm). Given the concept of ecological environments as interdependent, nested systems, gives rise to the research question of how these interdependencies can be empirically studied. For Bronfenbrenner (1977) — equally true for Anisa as a prescriptive theory — it is a research strategy — an ecological experiment — defined as follows:

> An ecological experiment is an effort to investigate the progressive accommodation between the growing human organism and its environment through a systematic control between two or more environmental systems or their structural components, with a careful attempt to control other sources of influence either by random assignment (contrived experiment) or by matching (natural experiment) (p. 517).

Within this definition, therefore, the field testing of Anisa can be viewed as an ecological experiment — a tranforming experiment. The alternative use of Campbell and Stanley's (1966) "quasi-experiment" is not applicable because it suggests a lower level of methodological rigor. The Anisa paradigm legitimizes both methods: an experiment of nature or an elegantly contrived experiment, depending on the purposes. Other methods are also useful, e.g., ethnographic description, naturalistic observation, case studies, field surveys, etc. Bronfenbrenner, however, emphasizes the critical role that the experiment plays in ecological investigations which not only test hypotheses but serve to detect systems-properties within and beyond the immediate setting. Bronfenbrenner (1977) states: "If you wish to understand the relation between the developing person and some aspect of his or her environment, try to budge the one and see what happens to the other (p.518)". This recognizes that the relation between person and environment has the properties of a system with a momentum of its own. In order to discover the inertia and interdependencies of the system, one can disturb the existing balance and see what transpires.

Using this perspective, therefore, the primary purpose of an ecological experiment, such as field-testing Anisa, is not "hypothesis testing" but "discovery", i.e., identifying those system properties that affect, and are affected by, the behavior and development of the human being. Thus, it is essential to identify such systems properties and include them in the research design before the fact. Since human environments are so complex with human beings adapting to and restructuring them, research models need to provide means for assessing and understanding these ecological structures and variations. Most mechanistic designs with their simplistic, unidimensional methods fail to capture and understand this complexity. In contrast, rather than "controlling out" the single variables, ecological research seeks to "control in" as many theoretically relevant ecological contrasts as is feasible within the design requirements. This permits greater generalizability beyond the specific situation and helps to identify the interactions of mutual accomodation between the growing child and its changing environments.

In Bronfenbrenner's judgment, the most demanding requirements of a research model for investigating the ecology of human development involve "...environmental structures, and the processes taking place within and between them" and,which he claims, "must be viewed as interdependent and must be analyzed in systems terms." Understanding these inderdependencies is the major goal of the ecological and/or organismic approach. Bronfenbrenner's efforts in this direction are reflected in a series of nine propositions outlining the requirements for an ecological model for research at each of the four successive levels (microsystem, mesosystem, etc.). These research methods, again, have important implications for the Anisa theory of evaluation; any differences are within theory and not paradigm differences. While Bronfenbrenner presents his ecological model as an improvement over the traditional (mechanistic) methods, he does not use the "paradigm" persepctive. It is my judgment that his work falls within the disciplinary matrix of the organismic paradigm comparable to Werner, Piaget, Bertalanffy and others. His work is most congenial and can be generally integrated within the paradigm perspective.

<u>Properties of the microsystem: reciprocity</u>. In the classical research model there are usually two participants — the experimenter, identified as E, and the subject, identified as S. The interaction operating between the E and S is viewed as unidirectional; the experimenter presents the stimulus, and the subject gives a response. While social behavior theory (organism-organism interaction) acknowledges that the process goes both ways, i.e., the principle of reciprocity is accepted, it is disregarded in research designs. Bronfenbrenner (1977) presents this in the following propositional form:

> In contrast to the traditional unidirectional research model typically employed in the laboratory, an ecological experiment must allow for reciprocal processes; that is, not only the effect of A on B, but also the effect of B on A. This is the requirement of reciprocity (p. 519).

As discussed in Chapters II and III, this research design deals with the mechanistic anomaly of efficient causation being only linear and unidirectional in a cause-and-effect relationship. A number of ecological experiments (Rennell et al., 1974) have been conducted based on the initial observations of animals and the mother-neonate interaction patterns following birth. Klaus et al. (1972) investigated hospital practices that resulted in minimal opportunity for contact between mother and her newborn child. Procedures were modified to permit mothers to have their infants with them for an hour after birth and for several hours daily. Using a randomly assigned control group design, the results were outstanding. The mothers in the experimental group were more attentive, affectionate, and concerned with their children's welfare. A two year follow-up and cross cultural replication gave similar results that were unequivocal.

The principle of reciprocity in these experiments was not fully investigated for the scientific focus was on the mothers. The results may well have occurred as a response by the developing infant and reciprocated by the mother in a progressively working pattern of interaction. The omission in the research design was the failure to take into account the total social system operating in the situation. Bronfenbrenner's second proposition deals with this issue:

> An ecological experiment requires recongniton of the social system actually operative in the research setting. This system will typically involve all the participants present, not excluding the experimenter. This is the requirement of recognizing the totality of the functional social system in the setting (p. 520).

This proposition becomes significant when considering systems involving more than two persons. This method, therefore, is appropriate for the experimental designs called for by Gadlin and Bandura, which were discussed in Chapter III. Again, the Anisa theory of pedagogy epitomizes this experimental method, wherein the teacher arranges the environments and guides the interaction in order to release the child's potentialities at an optimum rate. This interaction provides the necessary efficient and reciprocal causation. Since Anisa is a prescriptive theory, the teacher, following the diagnosis of the child's developmental level, uses the theory of teaching to accomplish the goals of the content and process curriculum. This provides not only the necessary but the sufficient conditions for development — final causation. This latter condition, however, is not considered in Bronfenbrenner's proposition. The use of Feuerstein's instrumentation (LPAD) in a teaching-learning process with Piaget's "clinical method" integrates the design issues of reciprocal causation and instrumentation. Within the microsystem of a classroom Anisa practices can, in fact, serve as a prototypical ecological experiment including the emphasis on "discovery" and not on "hypothesis testing."

Classical psychological experiments usually allow for two participants — E and S. Where the investigators do take into account the activities of others in different roles, the behaviors of each are frequently treated separately and interpreted as independent effects.

For example, it has been demonstrated that the father-infant interaction alone may be quite different in the presence of the mother. This kind of indirect influence is regarded as a second-order effect. Seaver (1973) presents an outstanding study of a second-order effect in a classroom setting. He used an "experiment of nature" to study the questionable effects of induced teacher expectancies. He evaluated differences in achievement of pupils with older siblings who had the same teacher and achieved well or poorly. Seaver's "natural experiment" gave strong support to the teacher expectancy hypothesis.

Bronfenbrenner (1977) addresses this issue in the following propositional form:

> In contrast to the conventional dyadic research model, which is limited to assessing the direct effect of two agents on each other, the design of an ecological experiment must take into account the existence in the setting of systems that include more than two persons (N + 2 systems). Such larger systems must be analyzed in terms of all possible subsystems (i.e., dyads, triads, etc.) and the potential second — and higher order effects associated with them (p. 520).

Anisa practices offer possibilities for such ecological experiments, for an N + 3 system within a single context such as home or school is extremely rare in the literature. The Very Early Anisa Program (1979) provides teachers (Developmental Specialists) who work with pre-school children and parents in the home. This represents a typical N + 3 system that can be investigated. The extensive use of volunteer parents in the regular school setting (intermediaries in the teaching process) escalates the system from a triad to a quintet or, more generally, an N + 3 system and also represent appropriate systems for investigation.

Anisa practices are concerned with the quality of the interactions between and among three hierarchically classified environments: physical, human, unknown, and one that is the composite of the others — the Self. In many respects the easiest to arrange in order to accomplish the purposes of the curriculum is the physical environment. The impact of physical factors operating indirectly as higher order effects, however, have been frequently overlooked. For example, an ecological study of the effects of apartment noise on development (Cohen, Glass, and Singer 1973), found that children living on the lower floors of 32-story buildings near noisy traffic showed greater impairment of auditory discrimination and reading achievement than a matched group living in higher floor apartments. With respect to studies on the effects of television, most have been concerned with effects on the child concerning knowledge, attitudes, and behavior. The indirect effects on patterns of family life, let alone the physical effects on vision, etc., have not been investigated.

The most obvious effect in observing an Anisa setting is the physical environment. It is designed to accomplish specified purposes. Investigations of systems properties in the immediate setting are related to Bronfenbrenner's (1977) following proposition: "Ecological experiments must take into account aspects of the physical environments as possible indirect influences on social processes taking place within the setting."

Mesosystem: relations between settings. Research is generally carried out in the laboratory, the school, or the home but infrequently in more than one context at a time. The implications of an ecological approach allows for investigations of the same persons being in different settings. Thus, the experience of a child in day care, in the class, or peer group can change his interaction with parents with implications for learning. Bronfenbrenner (1977), in order to investigate the joint effects of more than one setting, provides the following proposition:

> In the traditional research model, behavior and development are investigated in one setting at a time without regard to possible interdependencies between settings. An ecological approach invites consideration of the joint impact of two or more settings or their elements. This is the requirement, wherever possible, of analyzing interactions between settings (p. 523).

Current Anisa practices offer many opportunities for investigating such second-order effects across both time and space. The implications of the propositions are to capitalize on those aspects that lend themselves to systematic investigation within the usual operations of a school system.

Since Anisa is primarily concerned with the release of both biological and psychological potentialities at an optimum rate, we are concerned with developmental changes throughout the life span. Much of the focus of past research in developmental psychology has been on aspects of the developing individual with little reference to context. Thus, development is frequently viewed as instigated by events within the organism. Although many events in the life cycle have been scientifically studied, few have been conducted, according to Bronfenbrenner, with the explicit purpose of assessing the impact of the experience upon the processes of development. There is the need, therefore, to study the successive shifts in role and setting that every person undergoes in his life span — ecological transitions. These transitions involve all of the settings and systems-properties already discussed. They entail changes over time in role, activity, and place (e.g., child at home to student in school, wife to mother, student to worker). The microsystem changes with marriages, births, graduations, work opportunities, promotions, divorces, and deaths. Since every transition involves multiple settings, reciprocal processes occur within and across settings involving higher order effects. When a child enters day care, family activities change; a divorce changes the student's behavior in school; dropping out of schools impacts on the family; a move to a new school affects every environment of developmental significance. The impact of an ecological transition on the development of the individual as well as other people in his life (e.g., family, peer group, etc.) is an unexplored but scientifically promising area of research. The reader may easily recall a number of such transitions and their resulting impact; it would be more difficult to find scientific studies in the professional literature that could prove relevant and helpful. My major transition occurred at age thirteen when my family moved from a small rural community to a major city. This single event had a significant impact on the course of my total development. Thus, Bronfenbrenner handles the developmental impact of ecological transitions in the following proposition which deals more with substance and scope than theory and method:

> A fruitful context for developmental research is provided by the ecological transitions that periodically occur in a person's life. These transitions include changes in role and setting as a function of the person's maturation or of events in the life cycle of others responsible for his or her care and development. Such shifts are to be conceived and analyzed as changes in ecological systems rather than solely within individuals. These transitions are not limited to the early years but recur in various forms, throughout the life of the person. Hence, the ecology of human development must incorporate a life-span perspective if it is to do justice to the phenomena within its purview (p. 526).

Some of these ecological transitons are being investigated and easier transitions planned in Anisa-Suffield, Connecticut. For example, the two private nursery schools were included in all of the Anisa training; the change from a private nursery school to the public kindergarten (which is also based on Anisa), therefore, is a relatively smooth transition. The Very Early Anisa Program, which provides services to high risk pre-school children in their homes, also addresses the transition problem. Findings over the last seven years show marked improvement over previous practices that were quite dysfunctional. Multi-age grouping of children in school with teaching staff involved with the same children over a two to three year period is providing evidence that these practices are more satisfactory than the usual abrupt transitions from grade to grade with new teachers each year.

<u>Exosystem: developmental settings in context</u>. The immediate settings in which the developing individual is functioning are also influenced by the external contexts in which they are embedded. For example, the nature of the parent's work, health and welfare services, government policies, relations between school and community and law enforcement practices are all circumstances that impact on the developing person. The difference in the ecological approach from the usual developmental research is that the latter, for example, treats social class as a linear variable rather than conceived in systems terms in which a person is a participant. Thus, the properties of the research model for investigating relations at this level represent sources of higher order effects from more remote area of the environment. They do not require any new principles; they are primarily heuristic by making researchers aware that the larger environment may be critical for understanding the process of human development. This is summarized in the following proposition (Bronfenbrenner, 1977):

> Research on the ecology of human development requires investigations that go beyond the immediate setting containing the person to examine the larger contexts, both formal and informal, that affect events within the immediate setting (p. 527).

While the impact of Federal legislation (PL 94-142) on special education, for example, is both positive and negative, the long-term negative effects may predominate if the mandated diagnostic and intervention procedures are followed. Project Inspire, which is applying Anisa to special education students in five communities in Connecticut, is experiencing the higher-order effects of this federal legislation.

The diagnostic procedures which result in labeling the child based on norm-referenced tests may well have long-term negative effects on the development of the child. Although many of the Anisa practices of diagnosing developmental levels and prescribing interventions without the formal medical model labels, (e.g.,"learning disabled", "emotionally disturbed", etc.) are being implemented, the higher-order effects of this federal legislation frequently precludes such practices. Research on the ecology of development should investigate these higher-order effects.

Bronfenbrenner's broader approach to research on human development makes a contribution that is congenial to the Anisa paradigm. In fact, many of his propositions can be immediately applied in field-testing Anisa; their elaboration in this presentation underscores this fact. While his major contributions to research methods are his systems approach and dealing with reciprocal causation, he fails to deal with change over time that involves hierarchic structures. It is in these areas that Bateson et al. make a contribution that deals with methods involving first-order and second-order change based on the Theory of Logical Typing.

First-order and second-order change. Watzlawick, Weakland, Fish et al. (1974) at Stamford University have used Bateson's ideas in their practices praticularly dealing with change related to psychotherapy. They operationalize Bateson's insights concerning hierarchic structures based on the Theory of Groups (Galois, 1832) and Russell and Whitehead's

Theory of Logical Types. It is beyond the scope of this study to fully delimit their work. Nevertheless, it is helpful to point out important segments that have already been empirically tested that contribute solutions to this major problem identified by the Anisa paradigm. Their work is an important step in providing a method with rules and procedures for solving one of the puzzle-forms related to change and hierarchic structures.

Their method has very significant implications for the Anisa theories of administration and evaluation. They focus on problem formation; that is, knowing the problem in order to do — or not do — something that will create change to get rid of the problem. They rely on the Theory of Groups which deals with the relationship of the parts and the whole to which they belong. Thus, members of a group are determined by any one characteristic. A group may combine members with change occurring but invariant in outcome (e.g., change spending activities regarding one's budget but total spent is the same). A group may have an identity member that can combine with any other member and the outcome is no different than the efforts of other member (e.g., 5 X 1 = 5; thus, a member can act without making a difference). A member may also have a reciprocal (e.g., -5 = -5, which also has an invariant outcome). Changes that occur within the system are changes that do not change the system as a whole. Such changes are referred to as "first-order change." Thus, if the problem is with the system as a whole, the attempted solutions will not solve the problem. The problem, therefore, has been wrongly formulated. If you don't know what your problem is, you can become confused.

Using Basteson's adaptation of Russell and Whitehead's Theory of Logical Types, one can transcend the system by making the distinction between the member and the class. (See pages 152-160). Bateson deals with the change of the change. Thus, using the Theory of Logical Types, there is a change from the member to the class; this change of change is referred to as "second-order change." First order change operates on principles applicable to members and not to the class. It is usually based on common sense (e.g., use more of the same to solve the problem. It is possible to get into a game-without-end where the system cannot produce the rules to get out of the rule system (e.g., Senate filabuster). Second-order change, however, is frequently characterized as unpredictable and even illogical. The principles for determining second-order change are difficult to formulate, frequently appearing to be intuitive. Nevertheless, once the new perspective has been understood, from the second-order change, it appears simple and lucid. Applying second-order techniques for the "solution" means that the techniques deal with effects and not presumed causes; the questions are <u>what</u> and not <u>why</u>. In addition, second-order change techniques lift the situation out of the paradox-engenering trap created by the self-reflexiveness of the attempted solution and puts it in a different framework.

The use of first-order and second-order change techniques provide an important method in problem-formation and problem-resolution that should be systematically incorporated and applied within the Anisa theories of evaluation and administration. For example, there are many educational practices where first-order change efforts are attempted with "more of the same" resulting in the solution to the problem becoming the problem (See page 208). The current (dictated by state legislatures) educational approach to dealing with accountability is to attempt to solve a problem by norm-referenced achievement testing of students at selected grade levels. Those identified below given percentile ranks are provided with essentially more of the same. This mechanistic, industrial conveyor-belt analog that school systems are using is largely the problem.

The Anisa Model with its emphasis on the unique ability of the individual and not the "normal curve" may offer a second-order change. This new perspective is concerned with establishing a bond with the child (mediated learning) where the concern is with modifiability, uniqueness of the child, and his capacity to create possibility. The whole system operates on new principles. The focus of this study is how to (1) evaluate that uniqueness; (2) find the unique strengths; and (3) develop a "transforming experiment" where the quality of the interactions with the new enviroments will also release uncommitted potentials in the genotype. The focus is on the individual's subjective aim, purposes, and aspirations.

In general, I am suggesting that the Anisa paradigm with its new perspective — new world view — may represent an out-of-system (second-order change) solution to many of the existing educational problems that are dominated by mechanistic first-order change efforts.

Idiographic versus nomothetic methods. The idiographic-nomothetic issue has a long hisotry, but serious consideration in psychology began with Gordon Allport (1937). His efforts were to make psychologists aware of the effects that models of human behavior have on the type of scientific evidence subsequently gathered. He introduced the germs idiographic and nomothetic. Allport (1937 states:

> The former (nomothetic methods)...seek only general laws and employ only those procedures admitted by the exact sciences. Psychology in the main has been striving to make of itself a completely nomothetic discipline. The idiographic sciences, such as history, biography and literature, on the other hand, endeavor to understand some particular event in nature or society. A psychology of individuality would be essentially idiographic (p. 22).

Marceil (1977) suggests that this terminology alerted psychologists to the "slavish subservience to these (mechanistic, nomothetic, operational) presuppositions (p. 1047)." By using "idiography" he suggested other possibilities that psychology could take about the nature of man. Allport's image of man, Marceil (1977) indicates, is suggestive of a telic theory of man. His statement, "Let us simply define intention as what the individual is tying to do." This is analogous to "subjective aim." Allport's (1937) later concept of "functional autonomy", which he described as the "declaration of independence for the psychology of personality" (p. 156), also establishes his telic image of man.

Allport faced the same problem we have today: nearly all psychological research advances a mechanistic view of man with the most sophisticated methods designed to fit this view. He suggested the development of idiographic methods that would highlight uniqueness, identity, will, and other humanistic concepts. Nevertheless, Allport (1946) states:

> I try in my book to offer nomothetic constructs that improve upon those traditionally employed. While they are nomothetic in nature, many of them have an id graphic intent (p. 133).

Regardless of whether he was confusing "theory" with "method" issues by not being able to sort them out, the debate over the idiographic-nomothetic methods has persisted. Attempts at resolution have been made, but the most promising reformulation is made by Marceil (1977). Drawing on Rychlak's definitions of theory and method, Marceil makes a distinction between the two that leads him to formulate his "theory versus method matrix." Rychlak (1968) defines method:

> A method is the means or manner of determining whether a theoretical construct of proposition is true or false. Methods follow theories, though one can work back from a method to a new or modified theory (p. 43).

The distinction between theory and method is important for it can create confusion. For example, the terms "stimulus" (S) and "response" (R) are theoretical constructs because they have a hypothesized relationship to one another. In contrast, however, the terms "independent variable (IV) and "dependent variable" (DV) belong to the realm of method favoring no theoretical prediction. By making this distinction, Marceil develops a classification system to order the theory and method dimensions of the issue.

Using a concept from Kluckholm and Murray (1949) which states that every man is "like all other men, like some other men, and like no other men" there was an attempt to sort out the styles of research in these three categories. Thus, we can make our choice of method the selective examination of many subjects or the intensive examination of a few subjects. There are two analogous theoretical positions taken with regard to the nature of man: man is more similar than different from his fellow; or, man is more different than like his fellows. The theory and method assumptions are brought together to form a matrix as shown on Table 1.

Table 1
A Theory Versus Method Matrix

Method assumptions	Theory assumptions	
	A. Man is more alike	B. Man is more unique
A. Selective examinations of many subjects	AA	AB
B. Intensive examination of few subjects	BA	BB

The "AA" theory-method combination shows how the two fit together. Thus, in strictly mechanistic science, it is assumed that all subjects within a class are homogeneous in structure; eliminating the need to test more than a few subjects. The factor analytic school characterizes AA position.

The "true idiographic" apprach is BB. As examples, the researcher can use the ipsative approach (which assumes that the individual is a self-contained universe within which variations occur) or Stephenson's (1953) Q sort to see how an individual's scores vary from his own mean in a unique pattern. The "N = 1" research legitimizes the use of single subjects. In addition, many true idiographic studies are case studies (e.g. Allport's (1965) Letters from Jenny and White's (1975) Lives in Progress).

The "BA" assumption holds that there is some degree of species homogeneity of processes. Therefore, it is not necessary to study large numbers. The use of extensive and intensive designs can be selectively used. Thus, in an intensive design (those with an N of 1 or a few), the subject serves as his own "control"; the background variables such as sex, age, socio-economic status are kept constant. Hard statistical relationships found in extensive designs are not the goal, but, once a reliable relationship is found in a single subject, other subjects can be studied to see if the relationship obtains from subject to subject. Ebinghaus used this strategy when he used himself as subject in the study verbal learning.

Marceil's theory-method matrix expands the debate beyond positions of the "purist", "true idiographic", and "true nomothetic" who have been debating for the last forty years. The issues, nevertheless, will persist. They are not defined within a given paradigm, but they do offer a further clarification of some of the problems raised by the Anisa paradigm.

Of the variety of meanings that Kuhn (1970) attributes to the term paradigm, two meanings seem basic and complementary. First, a paradigm denotes "...one sort of element in that constellation (of beliefs, values, techniques shared by the community), the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science (p. 175)."

Anisa, now in the "normal science" stage, is concerned with the solutions to these remaining puzzles. This is related to Kuhn's second meaning of paradigm which is the "entire constellation of beliefs, values, techniques, and so on shared by the members of a given community." The emerging community of Anisa scientists, therefore, have a great deal of mopping up work to do in solving the many remaining puzzles.

CHAPTER VIII

SUMMARY AND PROJECTIONS

My professional career has been guided by attempts at answering the following questions:

1. What does it mean to be intelligent with respect to personal and social change?

2. How can I and the school foster that intelligence and change?

The answer to the first question was largely determined by my professional training as a psychologist. The field of psychology, in its desire to base its practices on scientific theory, defined "intelligence" as rooted in a substantive body of scientific knowledge. The mechanistic paradigm was and remains the dominant science; mastery of its rules and procedures was necessary as a legitimizing process for entry into the profession. Since training has a controlling effect on the developing mind, "intelligence" was therefore defined as scientific in contrast to philosophical or theological knowledge. As a teacher (professor), psychologist, director of research, and superintendent of schools, I attempted to foster that "intelligence." The answers to personal and social change were implicitly subsumed under the mechanistic view of the world. Developmental psychology answered questions of personal change; social psychology offered the empirical basis for social change. In general, the latter defined strategies of change as revolutionary, reform, or planned change.

The terms of "intelligence" and "change" have, however, remained "weasel words" when operationally defined within mechanistic science.

Initial attempts at basing professional practice on these concepts provided many first-hand experiences documenting great gaps between theory and practice. While "scientific methods" were applied, they dealt with a very narrow spectrum of phenomena. It was emerging, in fact, that "method" determined what problems would be attacked. The usual caveat found in most research reports that more research is required before... also illustrates the frustration that practitioners face in decision-making. The implicit assumption holds that the "scientific method" — given sufficient resources and time — will solve the problem. This internalized trust in the proper application of the "scientific method" frequently created a sense of guilt in that I blamed myself for not using the "methods" properly — it is a poor carpenter who blames his tools. Counter-instances and anomalies based on first-hand experiences were seen as personal failures and not the consequences of inadequate "methods."

These were symptoms — not recognized at the time — of the crisis faced by the mechanistic paradigm. There was a blurring of the paradigm and the loosening of the rules of normal research. Many of the practices (e.g., research in the field) paralleled research characteristic of a pre-paradigm period. This dissertation has provided me, and hopefully, the reader, with a more satisfactory answer to these questions by redefining both "intelligence" and "change." In fact, the Anisa Model offers the most elegant answer by not only defining intelligence as a new scientific (organismic) paradigm but also by integrating an answer to the more profound question of "change." It has and continues to provide me with an answer to how I and the school can foster that "intelligence" and "change." Thus, my professional practice, simply defined, is practice based on a substantive body of empirical knowledge. In current educational practices — it is difficult to characterize education as a profession by the above definition — espoused theories and theories-in-use leave much to be desired. The formerly espoused mechanistic theory with its anomalies and counter-instances leads to theories-in-use that create a sense of guilt. To remain committed to the paradigm one had to blame one's self rather than the tools — the "methods" of the science. A consequence of this study was to show that the methods of mechanistic science were, in fact, inadequate, creating a crisis of confidence. The study demonstrates how the Anisa Model deals with the crisis by creating a new scientific paradigm for education; therefore, providing the most elegant answer to my basic questions.

Criteria for Assessing Scientific Theories Re: The Anisa Model

This dissertation establishes criteria for addressing empirically based scientific theories. These criteria are then applied to the Anisa Model to determine if it qualifies as a scientific theory. In brief, the scientific process involves three interrelated steps: (1) observation; (2) model building (i.e., data language, assumptions, and testable hypotheses); and (3) empirical verification in the real world.

It is demonstrated how Anisa fulfills the first observational step by documenting the units of study upon which the Anisa Model is based. Jordan initially took man as his basic unit of study. Since Whitehead's organismic perspective was finally selected, man was viewed as being at the apex of a hierarchically organized universe. Within this organismic view, the primary unit of study is "change", the most pervasive characteristic of the universe. Change also means process and process presupposes potentiality. At the most general level, therefore, the units of study are those patterns of energy transformations involved in the process of translating potentiality into actuality. In a hierarchically organized universe, this involves general systems that can be abstracted for study involving the traditional thing-thing, organism-thing, organism-organism, and organization-organization interactions. Theories of these interactions, therefore, involve the physical, biological, psychological, and social sciences. In addition, the Anisa Model deals with the spiritual nature of man. Thus, the Anisa Model provides a total cosmology consistent with the "big bang" theory that deals with the reductionist issue within a general theory of organization. It qualifies as a metaphysical system that handles the whole of the proverbial elephant.

The second step in the scientific process is model building. This involves data language, assumptions, and the ability of the theory to generate testable hypotheses. It is demonstrated how the Anisa Model fulfills these criteria. It is notable that Jordan makes explicit the underlying assumption of the Model: the first principle is the concept of process as the translation of potentiality into actuality. This is also a fundamental definition of creativity. This underlying assumption of the Anisa Model sets forth the proposition that evolution is an expression of this process and man is at the forefront of evolutionary development. The Model further assumes that the purpose of education is the release of human potential in constructive directions at an optimum rate. A further implication of this assumption is that education is a part of the conscious and intentional effort to guide the future direction of evolution.

From this basic assumption, Jordan derived a coherent body of theory deductively generated from this first principle and inductively validated by empirical research, where possible. Jordan then formulated a comprehensive theory of human development. Development is defined in terms of the first principle — the translation of potentiality into actuality. The theory defines two types of potentiality: biological and psychological. Nutrition is the key factor in the actualization of biological potentialities. Learning, defined as the capacity to differentiate, integrate and generalize, is the key to the release of the five basic psychological potentialities — psychomotor, perceptual, cognitive, affective, and volitional. The terms comprehensive and coherent are applicable to the Anisa Model for the Theory of Pedagogy and the Theory of Curriculum are interrelated with the Theory of Development and the Theory of Administration. This study's main thrust is a further articulation of the Theory of Evaluation. In general, the data language of Anisa — its definitional terms — are coherent and straightforward. While they are precise, there is an abstract quality that contributes to Anisa as a generative theory which permits the practitioner to apply concepts to a wide range of learning situations.

The third and very significant step in assessing a scientific theory is its ability to generate testable hypotheses. Since the Anisa Model has been field-tested at several sites beginning in 1973, there is a growing body of empirical evidence supporting its effectiveness. The Model has generated hypotheses concerning the relationships between educational experiences and outcomes for both students and staff. In general, all of the "hard methodologies" explicated by Campbell and Stanley (1966) for hypothesis-testing are applicable. Traditional research designs using control groups, norm-references instruments, and statistical procedures have been used demonstrating positive findings. Anisa is concerned with longitudinal change in the student and organization, few of these type of hypotheses have been tested. Although proposals have been developed for creating the necessary instruments for measurement, the needed funding is not yet available. In addition, new research methods specifying testable hypotheses are required to deal with new phenomena (e.g., reciprocal causation, emerging hierarchic structures, etc.). Nevertheless, the Anisa Model viewed from this essentially mechanistic framework, fulfills the criteria of a scientific theory. It is notable that Anisa as a theory can be evaluated separately from the characteristics of implementing Anisa in the field. However, the bridge from theoretical hunch-land to the land-of-verification is a crucial process in the view of many scientists. This view essentially holds that experiments can be designed to test the theory empirically. Differences between competing theories are ultimately to be resolved by empirical testing. Thus, scientific knowledge follows a logical and rational process frequently characterized as the building-block or accretion process of scientific development.

Growth of Scientific Knowledge: Paradigm Perspectives

Many historians of science question the concept of development-by-accumulation. Thomas S. Kuhn, for example, takes a significantly different approach to the growth of scientific knowledge. The Kuhnian perspective is used to evaluate the Anisa Model and its role in the growth of scientific knowledge. Illustrations from the mature physical sciences are used to demonstrate parallels with the development of Anisa as a major shift from the mechanistic to an organismic paradigm.

Scheme of scientific revolutions. According to Kuhn, therefore, a scientific paradigm begins with a great discovery, frequently announced in a book. Underlying this grand discovery is a presupposition(s), sometimes explicitly stated; often it is implicit until the paradigm as a whole is challenged. A consequence of the paradigmatic discovery is the development of a general theoretical matrix; this, in turn, gives rise to a method that is the basis for further discovery and articulation of theory into new areas. The paradigm defines its own data and legitimizes some data that were not previously acceptable for "scientific" study. The method generates new applications that, in turn, will solve new puzzles. This process of puzzle-solving continues until a number of unsolved puzzles or theoretical anomalies are discovered that then creates a crisis for the scientists working within the paradigm. This gives rise to "extraordinary science" where a scientist will make a new discovery that resolves the crisis, creating a new paradigm. The resulting paradigm represents what Kuhn calls a scientific revolution.

Anomalies of mechanistic paradigm. This study identifies the following anomalies of mechanistic science. First, mechanistic science is primarily concerned with efficient causation; it does not deal with formal or final causes. In addition, efficient causation is viewed as linear or unidirectional with effect dependent upon cause. It cannot deal with reciprocal causes. Second, mechanistic science holds to the reductionist position; it cannot deal with emergent qualities of an organized whole. Third, the mechanistic view holds to antecedent-consequent relations as contrasted with structure-function which involves the attribution of purpose to man as an inherent function. Fourth, the mechanistic view of reactive man holds that all change is continuous and predictable from previous states — continuity. It cannot deal with discontinuity (but connected) where new properties are emergent, resulting in a whole which cannot be predicted from the parts. Fifth, the mechanistic view holds time is an absolute consistent with the universe as a machine where cause-and-effect relationships hold for past, present and future. This has served as the "time independent" criterion for science which is one basis for the crisis in social psychology. Other evidence from neurological studies (e.g., EEG) indicate that in this frequency domain time and space collapse and everything happens at once. The organismic view, in contrast to the mechanistic view, holds that time is a measure of motion rather than motion being a measure of time. Sixth, the experimental methods of mechanistic science deal with the subject-experimenter as a person-thing relationship. It does not deal, as is required in education, with the student as both object and subject. The introduction of subjective aim more adequately deals with this issue. Seventh, mechanistic science is amoral or neutral — it states "what is." It does not deal with the axiological concerns of values, ethics, and morals. It cannot answer the "ought" questions; it deals with means and not ends. The organismic approach finds these issues viable.

Paradigm shift: mechanistic to organismic. This study demonstrates how the Anisa Model, viewed within the Kuhnian perspective, deals theoretically with these anomalies. The Anisa Model represents extraordinary science by the way in which it deals with these anomalies. The Anisa presuppositions concerning the nature of reality as expressed in its first principle — change — answers the basic questions that a scientific group requires for scientific research. What are the fundamental entities of which the universe is composed? What questions may legitimately be asked about such entities and what techniques employed in seeking solutions? The basic metaphor of Anisa is the living organism, an organized whole. In contrast to the machine metaphor of the mechanistic paradigm, the organismic paradigm views the whole as organic and is equal to more than the sum of its parts. The whole is in continuous transition from one state to another through differentiation, integration, and generalization. The progressive change is not the result of only efficient cause-and-effect but involves subjective aim and final cause. The introduction of subjective aim and final cause are the key factors in Anisa representing a shift from the mechanistic to an organismic paradigm.

A paradigm is, however, more than a scientific group's shared commitments; it is based on shared examples — the "exemplar." Force is equal to mass times acceleration (f = m x a) served as the exemplar for Newton's paradigm. The exemplar for the Anisa paradigm is learning. Jordan defines learning as the conscious ability to differentiate aspects of experience, integrate them into novel patterns, and generalize them to new situations. It seems intrinsically appropriate that "learning" should be the exemplar for a paradigm for education.

The Anisa Model, in Kuhn's framework, could be viewed as representing "extraordinary science" by the way in which it theoretically assimilates the anomalies leading to a paradigm shift. While the field of education could be considered at the philosophical or pre-paradigm stage, according to Kuhn, the Anisa Model appears to qualify for paradigm status. The mechanistic paradigm has been primarily evident in educational research with small islands of educational practice based on mechanistic theory (e.g., Skinner's learning theory). While Anisa does not bring education to a dual paradigm science, nevertheless, it qualifies as a scientific paradigm for education.

Anisa Paradigm: Normal Science Stage

Qualifying as a new paradigm, Anisa, therefore, moves into the "normal science" stage of paradigm development. If it is to prove viable as a paradigm, it must determine the legitimate research approaches to be used. This is the mopping-up work of solving those legitimate problems posed by the paradigm by essentially organizing ideas about nature into the new boxes that the paradigm supplies. This involves converting problems into puzzle form so that they can be solved by rules and procedures acceptable to the cohort of scientists committed to the paradigm. These scientists have a commitment to understand the world and extend the precision and scope with which it has been ordered. There is a network of commitments — conceptual, instrumental, and methodological — that relate normal science to puzzle-solving. It provides the rules that tell the practitioner what both the world and his science are like. This dissertation explores the implications of these conceptual, instrumental, and methodological commitments.

Conceptual problems. The Conceptual problems are addressed first for they deal with the significant facts of the paradigm. Since the basic presupposition of Anisa is change, the basic facts concerning change are explored. Jordan, drawing heavily on Whitehead, gives equal importance to change and stability — a dynamic balance exists between the two. Jordan's first principle adopts the concept of process as the translation of potentiality into actuality. Learning serves as the key concept of man's ability to consciously learn-to-learn and take charge of his own ontological and phylogenetic destiny. Learning, therefore, plays a key role in the process of change; it is the degree to which man is freed from efficient cause.

Jordan further operationalizes this into a comprehensive theory of human development which, in terms of the first principle, is the translation of potentiality into actuality. Two basic types of potentiality — biological and psychological — are actualized, based on the quality of interaction between the organism and specific environments, and resulting in structures that form character, identity, and personality. Thus, Jordan develops the theories of pedagogy, curriculum, administration, and evaluation as a further definition of his presupposition concerning change.

There are, nevertheless, conceptual problems related to change that still need to be solved. Consistent with the Anisa theory of evaluation, which has as its primary goal the continuing evaluation of its first principles, some of these problems need to be converted into puzzle form for which there is a possible solution. Gregory Bateson makes just such a contribution to this "normal science" stage of Anisa development.

Learning and evolution: a single unity. Bateson integrates evolution (genetics) and learning (epigenesis) into a single unity. While learning for Jordan is the key to the release of psychological potentialities, there are problems of applying the concept at the genetic and biological levels. For Jordan, differentiation and integration operate at these levels with generalization operative at the psychological level. Bateson, however, further articulates a process that appears to solve the problem of the Weissmannian barrier between somatic and genetic change. Jordan does not specifically deal with the problem. Bateson solves the problem by showing how two stochastic systems, working at different levels of logical typing, fit together into a necessary unity that combines the stochastic system within the individual (learning) with the other stochastic system in heredity (evolution).

Hierarchic structures. Since Anisa holds that the universe is hierarchically organized with man (mind) at the apex of evolutionary development, understanding these basic phenomena are the primary puzzles that the organismic paradigm needs to solve. One of the significant problems that is converted into puzzle form for which Bateson offers a solution is explaining hierarchic organization. While Jordan deals with this in a general way, Bateson offers a solution to this puzzle by applying Russell and Whitehead's theory of logical typing to real world phenomena of biology and mind. He takes the concept of "logical typing" out of abstract mathematical logic and uses it to map real biological and psychological events onto hierarchies we encounter in these real world systems. Bateson provides examples illustrating how hierarchic structures emerge; there is a zigzag ladder of form (calibration) and process (feedback) that operate at different levels of logical typing. Such an alternating ladder may help to solve a number of puzzles in the field of ethics, education, and evaluation.

Bateson's concepts of "calibration" and "feedback" help to clarify the relationship that exists between Jordan's concept of "leadership" and "management"; an analogous zigzag process operates which handles the discontinuity as change leads to a higher hierarchic level of organization (logical typing).

Reciprocal causation. Reciprocal causation — a circular, causal and feedback process — is operative rather than simple linear, unidirectional, efficient causation of the mechanistic paradigm. Bateson suggests that the central problem of Greek philosophy — teleology — is within possible solution using cybernetics and systems theory where self-corrective circuits provide the basis for adaptation of organisms. The problems of change, hierarchic organization, reciprocal causation, emergent phenomena, discontinuity, and time are all interrelated; they are discussed, with particular focus on each phenomenon. Bateson illustrates this by understanding self-correcting circuits used in designing the governor for a steam engine. Even at this physical level of thing-thing interaction, Clark Maxwell demonstrated that every system has relations to time; these time constants are determined by the whole and are emergent properties of the system. In describing events as though one were inside the circuit, it would be described in cause-and-effect terms (e.g., a change in A determines a change in B, etc.). However, when dealing with the circuit as a whole instead of relations between individual variables, we are comparing change with change involving a change in discourse — a change in logical typing. What is needed is an explanation in terms of the time constants of the total circuit. The variables at the stage of one level of discourse disappear at the next higher or lower level. Bateson (1979) observes:

> The truth of the matter is that every circuit of causation in the whole of biology, in our physiology, in our thinking, our neural processes, our homeostasis, and in the ecological and cultural systems of which we are parts — every such circuit conceals or proposes those paradoxes and confusions that accompany errors and distortions in logical typing (p. 109).

It is notable that systems — physical, psychological, or social — involving circular causation are capable of positive gain resulting in a runaway or escalating, vicious circle. There is no systematic knowledge of the dynamics of these processes. Ecology, as an emerging science, however, is a beginning. Bronfenbrenner's ecological approach is, therefore, quite consistent with Bateson's views. Many of Bronfenbrenner's ecological propositions presented in this work, however, are merely a step in this direction with the greatest emphasis on reciprocal causation, system's properties, and discovery of emergent phenomena. Bateson makes his greatest contribution by dealing with the larger spectrum, particularly hierarchic organization, logical typing, discontinuity, and time.

Bateson provides some helpful insights in understanding reciprocal causation and runaway systems. He observes that neither random genetic change and natural selection nor trial-and-error learning (thought) and selective reinforcement will necessarily work for the good of either the species or the individual. Man is capable of making choices that could lead to a runaway or escalating vicious circles that could be disastrous for the system. Choices could have short-term advantage for the individual but long-term disaster for the group when viewed at a different level of logical typing. To improve the probability of survival, therefore, an organismic theory of evaluation needs to map processes that the mechanistic theories with efficient, linear cause-and-effect relations cannot. On-going and long-term data from various hierarchic levels within a system and related interdependent systems need to be systematically obtained to permit the best decision-making for both the individual and the group.

Final cause. The organismic paradigm subsumes efficient causation and conceptually deals with phenomena involving reciprocal causation. Anisa holds to the active organism — contrasted with reactive man — which has subjective aim and final cause as inherent givens. Man is freed to some degree from efficient cause (instinct); therefore, he is able, through learning, to take greater charge of determining his own destiny. Anisa also holds that there is purpose or final cause regarding the direction of that destiny. Bateson may provide a resolution to the central problem of purpose (teleology) and consistent with Anisa but extending its scope. Translated into other terms, the concept of negative entropy is analogous to final cause, the universe can be viewed as an open system with process that tends toward an organized complexity. This indicates purpose, reflects an optimistic view, and represents Anderson's growth circle. However, it does not deal with vicious circles or degradation of energy — energy without a purpose.

Bateson, in unifying epigenesis (learning) and evolution (genetics), shows how they are related to the twin components of the second law of thermodynamics. He maintains that the random workings of probability always eat up order (negative entropy). However, to create a new pattern (workings of the random), a large number of uncommited alternatives (entropy) are necessary. Combining the two stochastic systems of epigenesis and evolution, which also follow an alternation of two species of steps (logical typing), Bateson is also able to deal with the related problems of change, hierarchic organization, emergent phenomena, discontinuity, and time. This concept expands the Anisa view of man: freed from efficient causation but is able, through learning, to make conscious choices within these stochastic processes where choice (selection) is made from the random. It places the concept of final cause in a different perspective; it allows for direction and purpose but warns against an oversimplified view of some ultimate goal of perfection. Again, a systematic theory of evaluation can play a crucial role in avoiding errors in decision-making concerning logical typing that could lead to runaway or escalating vicious circles.

Problems of self-reference: object-subject. Bateson draws upon Russell and Whitehead, who in their Principia Mathematica attempted to derive all of mathematics from logic without contradiction (i.e., eliminate paradox from logic, set, and number theory). Their Theory of Logical Types was to rid set-theory of its paradox. This was accomplished by introducing a hierarchy which prevented looping back inside language. For example, in a hierarchy we go from "class" to "class of classes", etc. Bateson's insight was to use the theory of "logical types" to deal with hierarchic organizations which, he maintains, are central to living systems.

The common element in paradoxes is "self-reference" or "strange loops" as illustrated in the paradox of Epimenides. Kurt Gödel's Incompleteness Theorem raised questions concerning Russell and Whitehead's work in showing the limitations of formal logic. However, it also focused attention on problems of understanding our own minds — consciousness. Since Anisa is concerned with these problems — problems of explaining itself — Gödel's theorem was explored. It suggests certain limitations in our ability to represent our own structure and the degree to which science in its demonstrative version of object and subject can use self-application of science (i.e., science studying itself as an object). It raises questions concerning Anisa, Kuhn, and Piaget.

Hofstadter, however, shows how Gödel's proof has implications for understanding consciousness. He holds that "strange loops" can serve as the explanation of emergent phenomena in our brains (e.g., ideas, hopes, free will, and consciousness). They result from the interaction (a self-reinforcing resonance) between different levels. The self comes into being at the moment it has the power to reflect itself. This self-reference appears to be the heart of all artificial intelligence and is significant in our attempts to understand how the human mind works. Gödel's and Hofstadter's works have important implications for solving some of the problems of self-reference. Since Anisa is not limited to the demonstrative third person approach of mechanistic science, the problems of object-subject need to be worked through. Anisa does introduce the person into its methodology and is concerned with explaining itself. While Piaget's epistemology and Kuhn's growth of knowledge are consistent with Anisa, Gödel's work offers additional insights into the limitation of such self-reference.

Instrumentation. To quantitatively and qualitatively measure the facts concerning change, hierarchic structures, time, etc., there is the concomitant need to develop appropriate instruments. Existing instrumentation, particularly norm-referenced measures, are critically reviewed and their role is redefined to more limited application. Promising alternatives are suggested (e.g., The Learning Potential Assessment Device, criterion-referenced tests, and process measures). Other areas of needed work are identified.

Norm-referenced tests. The development, uses, and abuses of norm-referenced tests are presented. Their development represents an example of how the mechanistic paradigm was able to convert the problem of measurement into puzzle form involving specific rules and procedures representing an outstanding puzzle solution. In fact, it provides a possible model to be followed by those who will be working within the organismic paradigm who need to convert into puzzle form the problem of measuring change in the individual (or group) over time. Norm-referenced tests are based on the assumption that given traits (e.g., intelligence, achievement, etc.) are randomly distributed. Procedures for test construction, administration, and interpretation were developed and refined. In order to quantify the measurement, an appropriate mathematics (e.g., Fisher's statistical Unit Normal Curve) developed. The rules and procedures have been highly developed creating an effective testing technology.

As a product of mechanistic science, normative statistics have been applied by psychologists and educators. The tests as "objective measures" have been used for evaluation purposes within the traditional research designs. Their use in these designs is largely limited to cross-sectional measures involving individuals or groups. They are also relatively effective for selection purposes (e.g., recruiting, student placement, etc.). They do not, however, effectively measure "modifiability", the uniqueness of the individual, nor changes in the individual or group over time. Their primary goals have been objectivity and prediction. While these have solved some limited problems, they have created a number of moral and ethical problems involved in the misuse of the technology and its theoretical underpinnings. Theoretical, technical, and ethical issues are discussed.

As a product of mechanistic science, normative measures largely achieve the scientific goals of objectivity, prediction, control, and quantification. They cannot, however, deal with the anomalies of mechanistic science, (e.g., means-ends, reciprocal and final causes, emergent hierarchic structures, etc.). Since the organismic paradigm subsumes the mechanistic as a special case, we do not have to throw the baby out with the bath water. Thus, norm-referenced tests have a more limited use particularly for short-term, cross-sectional measures involving traditional research designs. Norm-referenced theory is analogous to Newton's view based upon Euclidean geometry while Einstein's view is based on Reimman's mathematics. Einstein's general theory of relativity made Newton's terrestrial and celestial laws special cases but gave us a very different view of reality quite analogous to the view that Anisa offers. Thus, what is highly desirable is a mathematical system comparable to Reimman's that would enable measurement of uniqueness and individual development over time. While quantification is desirable in the further articulation of a paradigm, it is not a prerequisite; quantification may follow the intuitive solutions the new paradigm identifies.

Dynamic assessment: The Learning Potential Assessment Device (LPAD). Reuven Feuerstein, who studied with Piaget, developed the LPAD which is a radical modification of conventional norm-referenced psychometrics. Its philosophy, method, instruments, and techniques have significant implications for Anisa practices that can be immediately incorporated. Based on twenty-five years of empirical study, its theoretical orientation places it within the organismic paradigm. It makes a significant contribution to the testing technology oriented to assessing change in the individual over time. The dynamic assessment is a major step in converting the problem identified by the Anisa paradigm into a puzzle form which can now be solved with specified rules and procedures.

Feuerstein believes, fully consistent with Anisa, that change should be introduced as the central goal of assessment; situations should be created in which change can be elicited and then measured. It is change (growth) that Anisa seeks to provide. This "educational approach" (i.e., concern for modifiability) contrasts with the "prediction approach" which attained scientific legitimacy under mechanistic science. The paradigm shift to organismic thinking is the key to legitimizing the former. Feuerstein, while not consciously working within the organismic perspective, nevertheless, has taken steps in solving a major puzzle. His rules and procedures contrast sharply with conventional psychometrics. For example, he places major emphasis on change (modifiability) rather than predictability — focuses more on process than product. He dramatically changes the conception of the examiner-examinee interaction from an objective, neutral role to a reciprocal interaction which he calls "mediated learning." This parallels Anisa's view of "learning competence" through learning-to-learn. The assessment procedures are also analogous to the Anisa theory of teaching; on most dimensions each could serve as a prototype for the other.

J. McVicker Hunt makes the following observation, "...psychometric assessment of educability should never again be the same... Other investigators can build upon the very substantial foundation that Feuerstein has constructed." That "substantial foundation" represents a technology that can be immediately used by Anisa practitioners and the basis for refining the rules and procedures for solving the puzzles of measuring change central to the Anisa paradigm.

Criterion-referenced tests. Since Anisa is a prescriptive theory, many of its goals and specific objectives can be appropriately measured by criterion-referenced tests. Introduced in the 1960's, this testing technology has already developed to the level that criterion-referenced tests can now be considered as a constructive alternative to norm-referenced tests. They are particularly congenial to Anisa practices and can be used for on-going evaluation at two levels — diagnostic and instructional outcomes. They can ascertain an individual's status with respect to well-defined behavioral domains specified by Anisa theory. The advantages over norm-referenced tests are discussed. In general, criterion-referenced technology can be immediately used for evaluating aspects of the Anisa content curriculum.

Process measures. Since Anisa is equally concerned with the process curriculum as well as the content curriculum, it needs instrumentation to measure the processes which must be mastered in the development of learning competence in each of the major psychological potentialities: psychomotor, perceptual, cognitive, affective, and volitional. Hambleton et al. (1974) from the Laboratory of Psychometric and Evaluative Research, University of Massachusetts, in collaboration with the Anisa staff, conducted a review of the literature pertaining to process measures, collected available instruments, and developed measures for seven of the processes underlying learning competence. These involved the following: classification, seriation, verticality, attention, figure-ground perception, and cooperation. A great deal of effort is still required in this area. It will entail a strategy of basic research on the development of each process. It is notable that several proposals have been recently submitted by Jordan to the National Institute of Education for funding.

<u>Other techniques and measures</u>. A variety of observer rating scales have been developed. Working within an operations research framework, tailor-made instruments involving the participant-observer are quite appropriate for many Anisa practices. The systematic use of video-tape for immediate feedback and modeling have proved effective in practice to date and this procedure for pre- and post-observations is very promising. Initial exploration for using computer technology to assist the Master Teacher in recording, storing, and retrieving information on each child make this a feasible approach in the neighboring future.

In contrast to the normative strategy of measurement, the ipsative approach can be used. In essence, it assumes that the individual is a self-contained universe within which variations in behavior occur. For instance, Stephenson's (1953) Q Sort technique can be used by the teacher to determine how a given student's scores deviate from his or her own mean in a unique pattern — a true "idiographic" approach and fully appropriate for Anisa's view of man. While quantification for the idiographic approach is difficult, some statistical techniques have been developed. For example, Baldwin (1942) developed a personal structure analysis to study the unique pattern of the individual personality; Luborsky (1953) used factor analysis for his P technique which uses correlations between batteries of tests taken by one person over several occasions (If two symptoms fluctuate together from day-to-day, a high correlation will be obtained). In addition to these quantitative efforts, case studies of one form or another are also appropriate. White's (1975) Lives in Progress and Allport's (1965) Letters From Jenny are examples of the idiographic approach that could be used to illustrate the effects of Anisa practices.

Cognitive processes. This important but largely untapped area is central to the long-term implementation of Anisa. Cognitive processes operative in the brain are clearly identified by the Anisa paradigm. Interest in cognitive processes have taken on a new importance in the behavioral sciences. A creative multidisciplinary approach is most probable. Work on the split brain (Sperry, et al.) has produced results that are useful in diagnosing learning disabilities. Pribram's (1979) innovative work, suggesting that the brain may function like a holograph, shows much promise. While very complex technology may be involved, experience with the physical sciences suggests the length to which scientists will go in developing instrumentation if the paradigm poses the puzzle (e.g., radiotelescopes, holographs, etc.).

Methodological implications. Methodology is defined as the study of the variety of methods which can be used in different paradigms concerned with acquiring knowledge. The term "method" denotes a given scientific procedure specifying the rules and procedures which must be followed to achieve a given end. Based on the theory of logical types, methodology stands in the same relation to method as a class to one of its members. This study attempts to avoid this error of logical typing. The methodology underpinning the Anisa theory of evaluation is rooted in the methods of acquiring knowledge based upon Kuhn's concept of a scientific paradigm. Within this methodological framework, therefore, specific methods of investigation with their rules and procedures for solving defined puzzles are presented.

Mechanistic methods. Since the Anisa (organismic) paradigm subsumes the mechanistic, essentially all of the research designs already explicated by Campbell and Stanley (1966) are applicable for limited purposes. Thus, a variety of control group designs using statistical procedures (e.g., t-tests, analysis of covariance, etc.), are appropriate. These are useful in establishing efficient cause-and-effect relationships particularly with systems at the thing-thing and organism-thing levels of interaction. They are not as appropriate for systems involving organism-organism interaction where reciprocal and final causes are more operative. At this level, organismic methods are more adequate for they deal with the anomalies of mechanistic science (e.g., reciprocal and final causes, means-ends, hierarchic and emergent structures, etc.).

Organismic methods. The entire Anisa structure rests on the empirical base of its theory of evaluation. While there is a relationship among all of the Anisa theories, there is an integral relationship between the theories of administration and evaluation. The former orchestrates the total implementation of the Anisa Model guided by the data provided by the theory of evaluation. This is exemplified by Bronfenbrenner's concept of a "transforming experiment" — Anisa can be an example par excellence. As a transforming experiment, administrative decisions are guided by the prescriptive nature of Anisa theory with a reciprocal relationship between administrative decision-making and the data obtained from the research methods determined by the theory of evaluation. This study presents some of these methods and identifies problems that need to be converted into puzzle form for possible solution.

The initial research designs in field-testing the Anisa Model at two sites used a goal-evaluation model, emphasizing operations research within a general systems framework. The quality of the programs was evaluated in terms of the defined goals — both formative and summative. For future field tests, however, Bronfenbrenner's experimental ecological approach shows much promise. It incorporates in a much more comprehensive manner the initial designs, and is generally congenial with the Anisa paradigm. Based upon nine propositions, Bronfenbrenner deals with a number of problems that are converted into solvable puzzle form. Specifically, he offers experimental designs that more adequately deal with reciprocal causation. These are consistent with designs suggested by Bandura, Gadlin, and Piaget. His propositions also effectively handle the object-subject relationships in experimental designs. These are consistent with the Anisa theory of teaching and applicable in the context of the classroom. In general, the developing field of ecological science is making a contribution to the "normal science" stage of the development of the Anisa paradigm.

Bronfenbrenner's approach, however, does not adequately deal with a number of conceptual problems identified by Bateson, namely, change, hierarchic organization, discontinuity, and time. It is in these areas that Bateson et al. make a contribution using the theory of groups and the theory of logical types to account for first-order and second-order change. By analogy, many of the changes within the mechanistic paradigm represent first-order change where considerable activity is manifest but the outcome is invariant. The Anisa paradigm, however, represents a second-order change at a different level of logical typing. This perspective on change regarding problem formation and problem resolution provides a very promising approach to Anisa practitioners.

The Anisa paradigm, now emerging to the "normal science" stage, is concerned with certain ways of doing things that will be accepted as a matter of course. Much mopping up work is still required before both the mechanistic and organismic scientists will accept the same procedural evidence, implicitly or explicitly, as support for the paradigm. Since the Anisa paradigm subsumes the mechanistic, such procedural evidence will be required. The well developed, mature sciences have passed through stages where a chaos of disagreeing schools has been narrowed down to one major school with one unifying paradigm. It is my thesis that the Anisa presuppositions, exemplar, developing research methods, and theories move education to paradigm status. This dissertation has given it a name and a location for the expanding community of scientists committed to its constellation of beliefs, values, and techniques.

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APPENDIX A

HYPOTHESES ON THE NATURAL HISTORY OF REFORM MOVEMENTS

As a graduate student I had the opportunity to collaborate with the late Professor Goodwin Watson of Columbia University in studying reform movements in history. As a result of this research, he formed a set of hypotheses on the natural history of reform movements. These are presented in their most general form. Although Anisa theory relies on a strategy of planned change, the use of these hypotheses may provide perspective and insight for administrators implementing the Anisa paradigm. In addition, the Anisa paradigm as a "transforming experiment" in education will be disseminated with ripple effects that could be studied using these stages of development. It provides a broad, long-term, out-of-system perspective that should prove helpful for future Anisa practitioners.

1. Stages of Development. If the progress of a successful reform be graphed, with time on the abscissa and percent of acceptance along the ordinates, the ogive curve will rise slowly at first, more rapidly for its mid-section, and more slowly again approaching its ceiling as an asympotote. The Early Stage extends from the beginning to the first point of inflection; the Expansion Stage covers the period of rapid rise between the points of inflection; the Late Stage carries on to the end.

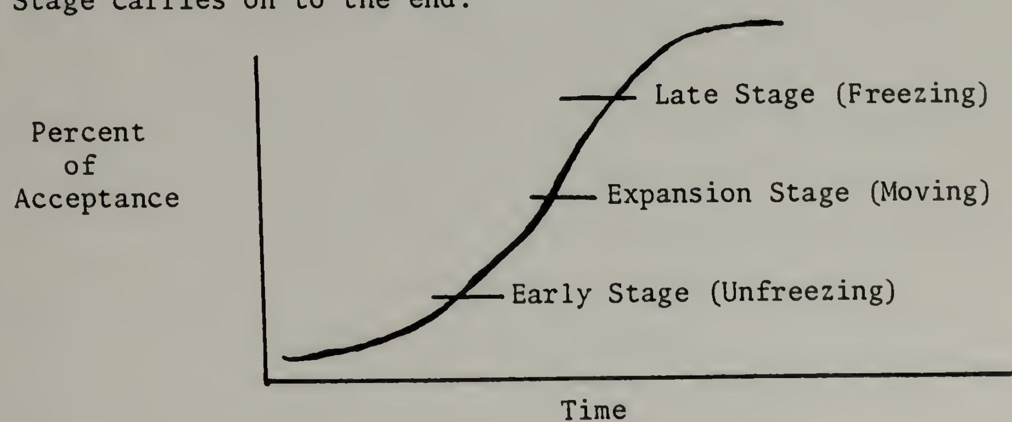

Figure 7.

EARLY STAGE

2. Complacency Disturbed. A reform movement begins with felt needs (vectors) which disturb the complacency (Quasi-stationary equilibrium) of one or more especially sensitive persons; attempted

extension of this disturbance to others arouses defensive resentment. One of the defenses is rejection of the pioneer proponents as "cranks."

3. Timeliness. The timeliness of a movement is inversely proportional to the length of the Early Stage. Timeliness is indicated by: (a) increased dissatisfaction with the situation to be changed; (b) weakened strength or prestige of the opposition; (c) facilitating discoveries or inventions; (d) support being given to similar or related endeavors; and (e) some striking incident or crisis.

4. Salience. The more deeply members are ego-involved and the more they feel their most vital interests to be bound up in a movement, the more ready they will be to sacrifice for it. Greater salience usually means more time devoted to the movement, more aspects of life penetrated by its influence. Salience is greater for pioneers and for top leadership.

5. Simultaneous Beginnings. Urgent social need often brings several independent organizations with similar goals into being at about the same time; rivalry ensues; some beginnings merge; others lose out.

6. Exaggerated Expectations. Proposed reforms lie at the fantasy level, less reality-bound and more subjectively perceived; hence, advocates anticipate more benefits than actually occur; opponents anticipate difficulties more dire than reality brings.

7. Unclarified Objectives. The supporters of a reform movement in its Early Stage have differing conceptions of the movement and are moved by a variety of conscious and unconscious motives. Unclarified purposes foreshadow later misunderstandings and schisms.

8. Urban Nurture. In larger cities, social movements can more easily find the necessary number of supporters; moreover, citizens are freer to adopt innovations than in closely supervised small towns.

9. Privilege and Progress. Reforms and innovations which improve community life without threatening the continued power of the ruling group are more readily accepted in communities where educational level is high, where economic conditions allow time and money for leisure, where there is tax leeway, where salaries attract professional leaders, and where there is energy for experimentation. Reforms which are perceived as directly or indirectly a threat to the ruling group and the values they support (and which in turn support them) can progress only by: (a) some conflict in the value systems with corresponding rifts in the unity of the ruling class; (b) perception by the ruling group of this reform as an acceptable concession or "token-solution" (See #18 below) warding off more

serious threats; (c) growing power of another class to enforce its interests despite opposition of rulers.

10. Training Increases Demand. Social demand for a service leads to improved training of personnel which in turn increases the demand.

11. Preliminary Defeats. After some growth, leaders of a movement are tempted to a premature trial of strength. They are misled by their own especially keen sense of the urgency, their encouragement by some progress after so long an effort, and their association with an unrepresentative sample of the population. The challenge of early defeat is critical for the future progress of the movement. Weak leaders give up; strong leaders learn more realistic methods.

EXPANSION STAGE

12. Climbers on the Bandwagon. As a reform movement enters the Expansion Stage, it attracts new types of support; (a) more "realistic", (b) more prestige, (c) more opportunistic, (d) more timid. This dilutes the salience concentration.

13. Redefinition. New personnel and leadership bring about redefinition of objective in a more conservative or compromising form.

14. Simplification. If a movement engages mass support, its appeal becomes oversimplified essentially to Right vs. Wrong; debate becomes stereotyped.

15. Half-way Dangers. A danger point in reform lies half-way between the old order and the new, when traditional patterns have been weakened but the new are not yet strong.

16. Competition and Consolidation. Rapid expansion fosters a proliferation of agencies competing for support and for control; at the same time, independent movements grow in relative power by merging with others.

17. Pass a Law. Reform laws passed too early in the development of a movement prove unenforceable by democratic consent; after the Expansion Stage is well along, legal sanctions hasten acceptance by the reluctant minority.

18. Token Solution. When a ruling group is under pressure to move but is reluctant to do so, attempt is made to offer a "token solution" which will seem enough to give some satisfaction to forces urging action but which will be only nominal and not real movement. Frequent devices are the appointment of a committee, institution of a survey, or passing a favorable (but implemented) resolution.

19. Concessions. (G-x). When a movement nears a goal, (G), opposition forces wishing to avert the worst, offer a concession amounting to (G-x).

LATE STAGE

20. Diminishing Returns. After the second point of inflection of the growth curve, each new member or dollar becomes harder and harder to get and drop-outs offset gains.

21. Bureaucracy. When enough has been won, the crusading spirit ebbs, leaving bureaucrats to operate the movement.

22. Opponents Reconciled. When a reform has become well established, conservative groups conveniently forget their one-time opposition, and may even become defenders of the social arrangement, preferring it to still more radical proposals.

23. Glorious Past. Celebration of glorious past achievements replaces creative attack on present problems; methods once successful continue even if no longer so effective (Functional autonomy).

24. Last Gasps. In dying movements, desperate measures are spasmodically tried, but in vain; dwindling support is further reduced by factional hostility arising from continued frustration.