CANADIAN THESES ON MICROFICHE

I.S.B.N.

THESES CANADIENNES SUR MICROFICHE

National Library of Canada
Collections Development Branch

Canadian Theses on
Microfiche Service

Ottawa, Canada
K1A 0N4

Bibliothèque nationale du Canada
Direction du développement des collections

Service des thèses canadiennes
sur microfiche

NOTICE

The quality of this microfiche is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us a poor photocopy.

Previously copyrighted materials (journal articles, published tests, etc.) are not filmed.

Reproduction in full or in part of this film is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30. Please read the authorization forms which accompany this thesis.

THIS DISSERTATION
HAS BEEN MICROFILMED
EXACTLY AS RECEIVED

AVIS

La qualité de cette microfiche dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de mauvaise qualité.

Les documents qui font déjà l'objet d'un droit d'auteur (articles de revue, examens publiés, etc.) ne sont pas microfilmés.

La reproduction, même partielle, de ce microfilm est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30. Veuillez prendre connaissance des formules d'autorisation qui accompagnent cette thèse.

LA THÈSE A ÉTÉ
MICROFILMÉE TELLE QUE
NOUS L'AVONS REÇUE

NL-339 (r. 82/08)

Canada

National Library of Canada
Bibliothèque nationale du Canada

Canadian Theses Division
Division des thèses canadiennes

Ottawa, Canada
K1A 0N4

63929

PERMISSION TO MICROFILM — AUTORISATION DE MICROFILMER

• Please print or type — Écrire en lettres moulées ou dactylographier

Full Name of Author — Nom complet de l'auteur

Michael Timothy Caley

Date of Birth — Date de naissance

8 Dec. 1945

Country of Birth — Lieu de naissance

CANADA

Permanent Address — Résidence fixe

11639-137 ST.
Edmonton, Alta
T5M 1N8

Title of Thesis — Titre de la thèse

Towards Biosocial Curriculum Theory.

University — Université

University of Alberta

Degree for which thesis was presented — Grade pour lequel cette thèse fut présentée

Ph. D.

Year this degree conferred — Année d'obtention de ce grade

1983

Name of Supervisor — Nom du directeur de thèse

Dr. D. W. R. Wilson

Permission is hereby granted to the NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

L'autorisation est, par la présente, accordée à la BIBLIOTHÈQUE NATIONALE DU CANADA de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans l'autorisation écrite de l'auteur.

Date

14 April 1983

Signature

Michael T. Caley

THE UNIVERSITY OF ALBERTA

TOWARDS BIOSOCIAL CURRICULUM THEORY

by

MICHAEL TIMOTHY CALEY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

DOCTOR OF PHILOSOPHY

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA

SPRING, 1983

THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR MICHAEL T. CALEY

TITLE OF THESIS TOWARDS BIOSOCIAL CURRICULUM THEORY

DEGREE FOR WHICH THESIS WAS PRESENTED DOCTOR OF PHILOSOPHY

YEAR THIS DEGREE GRANTED 1983

(Signed) Michael T. Caley

PERMANENT ADDRESS:

11639 - 137 Street
Edmonton, Alberta T5M 1N8

DATED 14 April 1983

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Towards Biosocial Curriculum Theory" submitted by Michael T. Caley in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

.....

Supervisor

.....

.....

.....

.....

Date 8 April 1983

ABSTRACT

The history of modern educational theory may be divided into three phases. These three phases may be characterized by a paradigm that determines the predominant conception of the forces controlling development and the role of education vis a vis those forces.

Modern education came into being as a result of the Industrial Revolution. It was determined that education ought to direct development such that each person would be prepared for and would be content with their particular "place in society". The dichotomies evident in the methods and goals of public and private educational institutions underscore this point. The initial phase, then, was characterized by a predominantly sociological paradigm. Development, it was believed, was and could be manipulated by sociological variables.

Later, as psychology began to be developed as a field of study, it was natural to begin to define development in psychological terms. Educational psychology rapidly became a definable field in its own right. Thus, the second phase of development was characterized by a predominantly psychological paradigm.

Both the first and second phases of development of educational theory either ignored or repudiated any biological basis of development. Recent advances in various biological sciences (i.e. neurology, ecology, ethology, anthropology) have shown that there are significant phylogenetic and ontogenetic biological variables in development. These sciences have been subsumed under the umbrella of sociobiology.

This dissertation argues for the logically necessary extension of educational theory into its third phase. In this phase, biological variables will be accepted as explanatory and non-trivial. Under the aegis of a biosocial paradigm, sociological, psychological and biological factors will be integrated into a complex system that will form a new paradigm for educational theory development.

ACKNOWLEDGEMENTS

To Dr. D.W.R. Wilson for allowing me to attempt the project, when others would not.

To Dr. A.D. MacKay for unflogging support from beginning to end.

To Dr. M.D. Jenkinson for incisive, critical support and stimulating suggestions.

To Dr. C.I.J.M. Stuart, who more than any other has influenced my thinking skills.

To my daughters Erin and Megan who have been living examples of the arguments in the dissertation.

To my wife Pat, financial supporter, typist of innumerable drafts, editor, emotional supporter and lover.

Last but not least, Mrs. B. Weidenhamer for her excellent rendering of Figure 2.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

> Among leading ethologists today there is a realization that the problems of knowledge, including the higher forms of human knowledge such as mathematics, can no longer remain outside the scope of biology. Biology must, for its own sake, provide some interpretation of knowledge in its purely organic aspects, these aspects, both phylognetic and ontogenetic, being very much the field of biology. (Jean Piaget, 1971, p.1)

In 1975, Edward O. Wilson published "Sociobiology: The New Synthesis". In this book, Wilson attempted to formalize the emerging discipline of sociobiology from the converging disciplines of ethology, ecology and evolution. As the name implies, sociobiology is concerned with the development of social behavior in all organisms. Wilson envisaged sociobiology as subsuming all of the sciences that deal with social behavior, including psychology, sociology, anthropology, philosophy, and the neurosciences.

Wilson's premise, vis a vis human behavior, is that the biological premise, usually taken for granted in psychology and sociology, is of vital importance. The biological premise holds that phylogenetic/ontogenetic factors of development are equipotential with environmental factors and that the biological factors underlay and influence the action of environmental factors. Therefore, developmental sciences will be subsumed by sociobiology as the importance of the biological bases of human behavior are further illuminated and integrated. In a very real sense, Wilson is predicting a reduction of the social sciences into sociobiology, since all behavior is biological in origin.

It should be noted here that the social sciences have usually accepted the biological premise of human behavior as trivial and non-explanatory in contrast to

environmental/cultural explanations. Accepting sociobiology as a viable discipline means that there will inevitably be some influence upon educational systems. The actual influence cannot be predicted, but the manner of the influence may, in part, be inferred by examining the influence of other theories upon education.

The following arguments will be developed in the dissertation:

1. education has a tradition of co-opting its theories of learning and social development and its concepts of the nature of man from psychology, sociology and philosophy;
2. previous co-options have not resulted in any significant changes in learning or development in children in education systems because the theories co-opted have been used to predict how children ought to develop within the established system (Stephens, 1967; Tanner and Tanner, 1980; Zais, 1976);
3. education has a tradition of accepting the biological premise of human behavior as trivial and non-explanatory;
4. sociobiology does and will provide a paradigm for investigating human development and behavior based on the biological premise as non-trival and explanatory;
5. sociobiology is currently influencing social sciences such as psychology, sociology and philosophy;

and therefore:

a) education will be indirectly influenced by sociobiology as it co-opts new or re-conceptualized theories from the social sciences;

b) education can be directly influenced by sociobiology if educators become familiar with its protocol statements, laws and theories;

but this influence will significantly affect educational theories only if:

a) educators accept the biological premise as part of a biosocial interactive system and not as a prescription;

b) a biosocial paradigm is co-opted as a means of generating new lines of questioning, new protocol statements, laws and theories about learning and social development stemming from a recognition of the adaptive significance of the phylogenetic and ontogenetic aspects of development.

Education historically has co-opted theories of learning and social development from independent research areas (i.e., psychology and sociology). It is reasonable to assume that attempts to co-opt some aspects of sociobiology will be made. References to sociobiology have already appeared in the education and related literature (Albury, 1981; Benham, 1978; Biggs, 1981; Dyer 1981; Lang and West, 1980; Magoon, 1978; Pugh, 1980, Rosenfeld, 1981). Inferences about the co-option can be generated. Those inferences will have theoretical and philosophical implications for education.

This dissertation attempts to assess those implications from a theoretical, philosophical position. Langer (1967) asserts this position as follows:

> The foundations of a theory cannot be factually proven right or wrong, they are the terms in which facts are expressed, essentially ways of seeing things. The value of a philosophical outlook does not rest on its sole possibility, but on its serviceability, which can only prove itself in the long run, by its multifarious turns, its amenability to mathematical or logical development, its scope and its applicability to actual findings. (p.xxii)

Langer's statement implies the development of new paths to investigation and to new questions about phenomena. This, in turn, ought to lead to whole new

realms of questions. In this dissertation, some implications of the manner of the co-option of sociobiology to education through philosophical and theoretical considerations of some aspects of its potential scope and its applicability will be explored.

Merton (1968) described three levels of theory development. In hierarchical order they are:

1. "Grand theory" which attempts an "all inclusive systematic effort to develop a unified theory". In this sense, Newton's theory of gravitation would be "grand theory" as would Mendel's theory of inheritance and Wilson's sociobiology.
2. "Middle range theory" which acts as "a guide to empirical theory". Evolutionary theories attempt to be both grand and middle range simultaneously by providing an all inclusive theory and by acting as a guide to research for the individual investigator.
3. Practical application in manipulating systems is the lowest level of theory development. Modern technology is a pervasive example of the application of theory.

Sociobiology will be related to education in the "middle range" as "a guide to empirical enquiry". Future studies, presumably, will be involved in direct application at the level of curriculum development and classroom instruction and in the development of "grand theories" of biosocial development.

The plan of this dissertation is as follows:

1. Chapter I. The historical antecedents of sociobiology and its major tenets are discussed. This is to help orient the reader and to provide a basis for later discussion.

2. Chapter II. "Scientific method" and reduction are discussed. Since sociobiology purports to reduce other theories of human development it is important that the methods of reduction be understood. Waddington's epigenetic theory of canalization as a paradigm for developmental theory is discussed as well. This is to provide the reader with an easily visualized model into which the various aspects of learning and social development can be inserted and manipulated. Waddington's model of epigenetic landscapes lends itself easily to the illustration of many developmental systems.

3. Chapter III. The discussion here covers various recent influences of sociobiology upon some of the traditional social sciences. Since education has always co-opted its theories of learning and social development from these areas, it is important to understand how they may be influenced by sociobiology. As the traditional social sciences are influenced, so also will be education to some greater or lesser extent.

4. Chapter IV. In this chapter are presented selected items about various biological systems that affect human behavior. It is demonstrated that the traditional acceptance of the biological premise as trivial and non-explanatory excludes a large body of protocol statements, hypotheses and theories that pertain directly to development; learning, social and cultural.

5. Chapter V. Here, some other theories that education has co-opted, that have attempted to include a biological component (eg. Maslow and Piaget) are discussed. These theories have been widely accepted but the biological premise inherent in them was ignored or dismissed by educators. Other theories (Hart, Shepard, Barker and Gump) have had little or no impact,

although their acceptance of the biological premise is much greater. A synthesis of three biologically based theories (Shepard, Hart and Stephens) is then attempted in a biosocial vein.

6. Chapter VI. Herein are presented three exemplars of biosocial approaches that have been attemped in developmental theory: Grumet's work at the "grand theory" level; some instances of research at the "middle range" level; Stanchfield's at the level of practical application.

These three exemplars show the potential of biosocial perspectives in curriculum theory and development when the biological premise is accepted as non-trivial and explanatory in human developmental systems. This demands an integrated bio-psycho-sociological approach in order to conceptualize development as the result of complexly interacting systems.

7. Chapter VII. In this chapter, following Langer, the argument that human systems of all kinds must now allow the biological premise to be taken for granted, is summarized. Therefore education, which deals with the ontogenetic development of children may accept the biological premise as presented within a biosocial paradigm.

Since sociobiology is concerned with the development of social behavior in all its manifestations in all organisms, it offers a potentially powerful basis for examining the development of social behavior in humans, and for formulating a concept of the nature of man. Also, since learning is such a vast part of the development of humans it offers new perspectives in the development of human learning theory.

It is the task of sociobiology to investigate these and other possibilities.

> In suggesting possible adaptive predispositions in human behavior, this is the type of system sociobiology has in mind. A flexible, modifiable and perhaps rather fragile set of inclinations but a potentially significant part of our biology, quite possibly grounded in the evolutionary wisdom of our past.
> (Barash, 1977, p.283)

It is not the concern of this dissertation to present a defense of sociobiology; it is to promote the co-option by education of sociobiology as a biosocial paradigm. It is presumed that the promotion of co-option has already been advocated in the educational and related literature, and that at least some authors have initiated co-option. It is concerned with how the co-option might take place and some of the implications of co-opting or adsorbing sociobiology into education. These implications arise primarily through two sources. The first source is indirectly through changes in the social sciences (i.e., psychology, anthropology, sociology, philosophy) as a result of sociobiological influences. This is the traditional form of co-option from independent research areas discussed above. The second source is directly through research by educators as they become conversant with data from human sociobiology. In recent years, educators have become more involved in the direction of research in learning and social develoment. Usually this takes the form of using co-opted theories to make new predictions about the function of educational systems.

In this dissertation, the concern is not with the development of new predictions, but rather, in Langer's sense, with the development of new questions and new paths of inquiry. Holton (1973) states this quite eloquently as follows:

> Since a chief aim of these essays is to raise new questions for research rather than merely to answer old ones, there has been no attempt to come to solutions that pretend to finality; rather, we shall be satisfied if we can

> open the topic wider and find interesting questions spread over several, previously separate, specialty disciplines. (p.15)

Following the arguments presented above, the correctness of the major tenets of sociobiology are not at issue. It is recognized, for example, that sociobiological tenets are at variance with the Popper and Eccles' (1977) view of the development of human culture. In this dissertation the major axiom is that the tenets of sociobiology have been and continue to be influential in psychology and sociology and thereby are of direct interest and concern to educational theory and practice.

Sociobiology then, represents a very real opportunity for education to re-examine its concepts of the nature of man and to ask, "To what aspects of education does sociobiology draw our attention and to what extent does it help or cause us to reconceptualize our ideas of these aspects?".

Present learning theory and social development theory as utilized by the social sciences and by education are essentially devoid of any evolutionary background. Also, there is no single paradigm that underlies learning theory and social development. The great learning theorists Loeb, Sherrington, Pavlov, Guthrie, Hull and Skinner have not worked from a single central paradigm. While their researches have shown how to manipulate various organisms, including Homo sapiens under very simple controlled conditions, individually they have given little insight into the complex behaviors demonstrated by all organisms under free-living conditions.

All of the theories of learning have within them some aspect of development. However, since they all contain some aspect of truth, a set is needed within which all of these subsets can be placed. Rather than arguing the relative merits of one theory versus another theory, we need to combine all the aspects

into a single unified theory of learning and development. It seems that the explanatory and integrative power of biosocial paradigms offers the initial steps for a more unified approach to curriculum.

I. SOCIOBIOLOGY

In this chapter, various definitions of sociobiology and an explanation of the emergence of sociobiology as a distinct discipline within the broad field of biology are presented. The presentation of a number of definitions is designed to give the reader a feel for the differences and similarities as seen by sociobiologists who have come to the discipline from very different backgrounds.

ROOTS OF SOCIOBIOLOGY

Sociobiology predates the publication of Wilson's book. The three roots of sociobiology are modern evolutionary theory, ecology and ethology (Barlow, 1980). Modern evolutionary theory as expounded by Mayer (1963, 1978) and Simpson (1963) is generally viewed as the reduction of Mendelian genetics by Darwinian evolution (Hull, 1974; Ruse, 1973, 1979). Ecology, the study of organism/environment interactions, has its roots in the studies of the natural historians of the 18th and 19th centuries and in the past few decades has become a quantified science. Ethology is the study of the behavior of organisms in the "natural" ecological setting. Konrad Lorenz and Niko Tinbergen are generally regarded as the modern fathers of ethology (Tinbergen, 1951). Wilson attempted to show how these three areas of theory together with neurology, psychology and sociology are subsumable under a "grand theory".

SOCIOBIOLOGY DEFINED

In order to relate sociobiology to educational systems we must first understand what sociobiology is about. Wilson (1975) defines sociobiology "as

the systematic study of the biological basis of all social behavior". He then goes on to expand this definition:

> For the present it focuses on animal societies, their population structure, castes, and communication, together with all of the physiology underlying the social adaptations. But the discipline is also concerned with the social behavior of early man and the adaptive features of organization in the more primitive contemporary human societies. Sociology (sensu strictu), the study of human societies at all levels of complexity, still stands apart from sociobiology because of its largely structuralist and nongenetic approach.
> (Wilson, 1975, p.4)

The "biological basis" referred to by Wilson is the evolution of traits or factors through natural selection and is analogous to the term "biological premise" defined in the Introduction. Sociobiology then, exists directly as an extension of Darwin's theory of natural selection, which is in turn the basis of modern evolutionary theory. Sociobiologists "want to understand animal social behavior as a product of Darwinian natural selection" (Ruse, 1979).

Freedman (1979) simplifies Wilson's definition:

> Mine is simply that sociobiology is the application of recently developed biological principles to behavior. And since biological principles are usually concerned with populations, sociobiology reverses psychology's focus on the individual, and views him, instead, as a pawn in broader, evolutionary, population-wide processes. Individual behavior is seen as a unique variation on the species theme, with the species the primary motif.
> (p.1)

Barash (1979, p.1) defines sociobiology as "the application of evolutionary principles to the social behavior of animals & that of human beings as well".

These various definitions indicate that to understand the underpinnings of sociobiology and its implications one must first be grounded in modern

evolutionary theory and in some basic biology. In Kuhn's (1970) terminology this means that one must understand the paradigms of modern biology.

SOCIOBIOLOGY AS A PARADIGM

> A paradigm constitutes a basic interpretive structure that serves to organize our inputs from the natural world. It provides unity to our experiences, and it interprets the data of our science. A paradigm may also go beyond the structuring of information already received, that is, it may selectively permit the reception of certain information and cause us to screen out data that do not "fit". Like the ever present gate-keepers of mythology, it may also restrict our world view and, without our consciously realizing it, it may even set limits on the phenomena of which we are aware. But even this process, while overtly restrictive, is creative. Thus, a good paradigm encompasses what is known, suggesting directions for future research. But, at the same time, it should not be so complete as to explain everything, therefore eliminating nothing. It should be useful, adjustable to a point, and, like any hypothesis, susceptible to refutation. (Barash, 1977, p.1)

The basic paradigm of modern biology is evolution through natural selection. The theory of evolution provides a unifying structure that allows for the integration and interpretation of new data about all living things. According to Barash (1977), "This is the heart of sociobiology: the application of evolutionary biology to the social behavior of animals, including Homo sapiens" (p.2).

Sociobiology, by providing a paradigm that allows the integration of data on social behavior and learning from many areas and levels of research can be a potentially powerful tool for educators. The integration of behavioral, physiological, neurological, psychological and sociological data will allow new ways of viewing the process of education and the relationship of education as a

formal enterprise to other aspects of society and will allow the development of new questions which could lead to developing new insights and new directions.

II. "SCIENTIFIC METHOD", REDUCTION AND EPIGENETICS

This chapter concerns itself first with the considerations of methodology in the sciences. It is important to discuss these concepts here since the topic is not sociobiology qua sociobiology but rather its relevance to education and the possibility of the reduction of sociobiology to education. There exists the possibility, certainly in Wilson's view, that education will be reduced to sociobiology, at least by default, as all the social sciences are reduced to sociobiology (Wilson, 1975).

Secondly, Waddington's concept of epigenetics is presented. His model of epigenetic landscapes is advanced as a simple, but powerful method for explaining developmental systems and sequences. Waddington's model was originally formulated with respect to embryogenesis but, as with many powerful concepts, can be generalized fruitfully to other areas of development, including psychology and sociology.

From the educator's viewpoint, epigenetics represents a potentially powerful tool for relating the real-life development of children to the theory of development. Since the model can be used in all developmental theories, it follows that biological, sociological and psychological theories can be related to one another and to children in direct, meaningful ways.

"SCIENTIFIC METHOD"

In discussing scientific method and reduction, it should be understood that the focus is upon science as an intellectual activity and not upon the day-to-day physical activities that an individual scientist might undertake in any particular

situation. In this sense, then, science may be conceived of as intellectual activity at three levels that define a logical structure (Bochenski, 1965).

1. Protocol Statements. These are written records of observed phenomena. Simplistically, they are not capable of further reduction. (In complex situations, protocol statements obtained reductively may lead to other protocol statements.)

2. Hypotheses and Laws. As a class of protocol statements is expanded, generalizations can be created that include most or all of the protocol statements. The protocol statements must be derivable from the generalization. If the generalization has not been verified it is an hypothesis. Upon verification it becomes a law. Interestingly, hypotheses and laws ought to suggest protocol statements that do not arise from direct observation or at least prior to direct observation. In this sense, protocol statements can be obtained reductively from other protocol statements, as described in (1) above.

3. Theories. As a class of laws is developed the third level of structure emerges. Generalizations of laws are theories and all laws in a class must be derivable from the theory. New laws not stated prior to theory development then, in principle, ought to be derivable from a theory and new protocol statements from the law. This, in turn, ought to direct the attention of scientists to look for a confirming observation.

Theories differ from laws in the manner that they can incorporate terms not found in laws. Laws, on the other hand, contain no terms that are not found in protocol statements. Theories, then, cannot be simply generalizations of laws.

The development of science, then, consists of a cyclic application of the three levels; protocol statements, laws and theories. Bochenski (1965) describes the process as follows:

> It generally happens in the development of the natural sciences that observation continues to generate protocol statements, and explanation, accordingly, continues to construct new laws. Usually, these new laws are "covered" at first by some theory already established; that is, they can be derived from such a theory. After a time, however, this theory is no longer adequate. In the early stages, as a rule, it is improved and modified so that it can continue to cover the new laws. Sooner or later, however, the time comes when it is impossible to extend it any further so as to explain all the new laws. Nevertheless it is still tolerated, as long as it is capable of explaining many laws. Finally, however, it becomes so complicated and inadequate that it has to be abandoned, being considered applicable at best to a limiting case. A new theory is sought for, and the whole process begins afresh. Neither the previous history of the natural sciences nor the logical analysis of their structure give any ground for supposing that this process will ever stop. (p.97)

This description is similar to Kuhn's (1970) concept of revolution in science. Bochenski's protocol statement and law development correspond to Kuhn's normal science paradigm. Theory development in Bochenski's sense is found as a two-fold process in Kuhn. In normal science the theory develops from complex generalizations and extensions of classes of laws. However, whereas Bochenski describes change in theory as an integral process, Kuhn sees theory change as the basis of revolution.

It is believed that this complex system can be illustrated through a simpler two-fold model. Science can be described as two interlocked processes:

1. Methodology of Experimentation (Note 1). This aspect consists of data collection and analysis (i.e., protocol statements and laws or normal science).

2. Methodology of Conceptual Unification (Note 1). This aspect consists of the generalizations of laws and theory development. (Normal science and revolutionary science in sequence.)

The accumulation of protocol statements is a necessary aspect of science, but real advances occur at the level of conceptual unification. The extent to which conceptual unification (theory development) can occur is a measure of the advancement of any science.

Conceptual unification of learning and social development theory within sociobiological paradigms can be used in education to re-evaluate concepts of the child, the teacher, the ecological setting of each, administrative frameworks, etc. However, conceptual unification within biosocial paradigms necessitates acceptance of the biological premise of human behavior as non-trivial and explanatory. Education has always accepted the biological premise of human behavior, but only as trivial and non-explanatory. The co-option of sociobiology is offered as a method of conceptual unification that must include the biological premise of human behavior as its basis. In this sense, then, sociobiology represents a paradigm from which to re-evaluate existing data bases; to generate new kinds of questions (not new predictions); to develop new parameters of interest.

Sociobiology should not, as has happened with other co-opted disciplines, be used to develop new predictions about development and behavior of children in existing systems. This will not advance or reconceptualize children's educational systems, or the role of various participants (eg. children, teachers, administrators).

Rather, it should be used to reconceptualize our ideas of development. Reiterating, to what aspects of education does sociobiology draw our attention and to what extent does it help or cause us to reconceptualize our ideas of these aspects? This question will be addressed repeatedly as the dissertation develops.

REDUCTION

In the previous section, a model of scientific method that emphasized conceptual unification as the method of advancement was given. The logic of how conceptual unification comes about was not addressed. In this section, the discussion will center on the process of reduction as the basis for the logic of conceptual unification in natural science.

First, deduction and reduction must be distinguished.

In deduction, the consequent is inferred from the antecedent and its condition statement; while in reduction the antecedent is inferred from the consequent and its condition statement (Fig. 1).

Figure 1. Differentiating deduction and reduction as logical processes. (Based on Bochenski, 1965)

DEDUCTION	REDUCTION
If A, then B	If A, then B
A	B
therefore, B.	therefore, A.

Reduction can be divided into two classes:

1. Progressive reduction occurs when the antecedent, whose truth is unknown, is taken as the starting point. The argument then is taken to the consequent, whose truth is known. Progressive reduction is called verification.

2. Regressive reduction occurs when the argument begins with the consequent whose truth is known and proceeds to the antecedent whose truth is unknown. This process is also known as explanation.

The logic of conceptual unification and/or reconceptualization emerges from the interplay of explanation and verification. As the data base grows by the accumulation of protocol statements, explanation gives rise to laws. Similarly, verification of protocol statements and laws leads to development of theories. Increases in data bases or the merging of data bases of previously disparate areas of research lead to new explanations and new verifications. It is at this level of research that conceptual unification and reconceptualizations occur. This is analogous to Merton's "grand theory".

As learning theory and social development theory are reduced, in the senses discussed, in traditional areas of biology and psychology and in the emerging areas of psychobiology, biosocial anthropology, and various aspects of the neurosciences, they can be subsumed under a biosocial paradigm. New questions will be generated in these various areas. Education will benefit from these new questions and conceptual unifications by co-opting these into its own area. However, to be most fruitful they must be co-opted in order to generate new questions in education and not as new methods of prediction.

EPIGENETICS

In the two previous sections, the discussion centred on empirical science and the role of reduction in those methods. The explication of the method of conceptual unification as a way of developing new questions about existing data bases and as a way of directing future research was developed.

In this section, Waddington's (1975) model of epigenetic systems is presented as a paradigmatic model to investigate all forms of human development; biological, psychological and cultural. In this sense, epigenetics can be considered as an inclusive process model.

Epigenesis is "the branch of biology which studies the causal interactions between genes and their products which bring the phenotype into being" (Waddington, 1975). DNA contains the information that results in the growth of a single fertilized egg into a differentiated mature functioning adult organism. It seems best to conceive of the DNA formation as a set of algorithms (operating instructions) that are flexible enough to accept a great deal of information from other sources (i.e., environment).

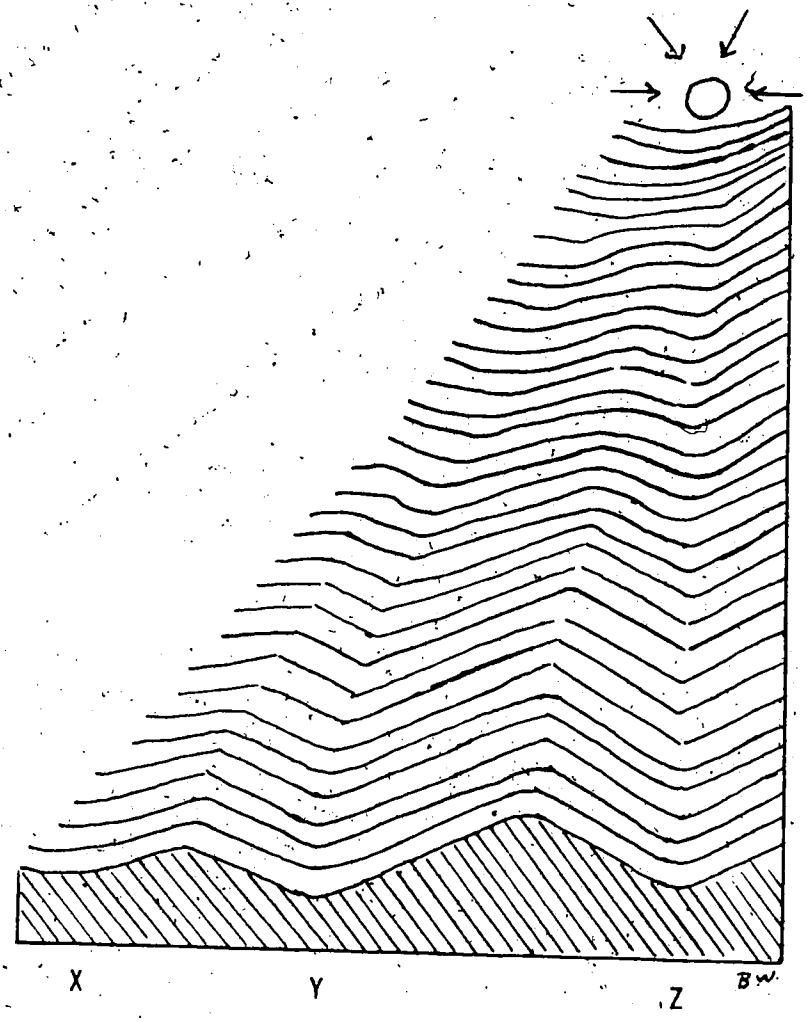
However, the basic algorithms are canalized. That is, the development of organisms usually shows a high resistance to change. The sequence of events that occur during the development of a fetus are quite rigid, to the point that very early in development, particular parts of the egg cell and later, particular cells, can be identified as the primordial cells leading to the development of quite specific organs or organ systems. Also, during development of an organism there are various processes that resist disturbances and cause a return to normal development. Since this resistance to change is in a dynamic flow situation Waddington refers to the interaction as homeorhesis rather than homeostasis. Piaget (1971) explains homeorhesis as follows, "the formatory process, deviating

from its course under outside influence, is brought back on course by the interplay of coercive compensations". If psychosocial development is seen as the interplay of factors in dynamic flow through time, then homeorhesis can be used to conceptualize this form of development as well as physical development. Development, then, is a complex interaction of bio-psycho-sociological factors.

In a homeostatic system the resistance is to change of state; in a homeorhetic system the resistance is to change of flow. Canalization of structure and function, then, is homeorhetic since development is a continuous process of change or flow. Waddington has suggested the term chreod (necessary route) to refer to the canalized path of development. Figure 2 shows diagrammatically the concept of chreods in development. As the ball rolls through the epigenetic landscape, environmental forces may direct it into particular chreods. Once a chreod has been entered it is usually not possible to reverse the process. It is seen that a single genotype then may result in various phenotypes. In this case, variation occurs as a result of genome/environmental interaction, not from mutation.

An important aspect of this can be seen in the neurological development of children. Sub-optimal nutrition obviously has the potental for drastic effects upon development. When children are subjected to sub-optimal nutrition it is impossible for the genetically controlled potential for growth to be realized. Growth is a stage process and sub-optimal growth at earlier stages cannot be made up at later stages. Thus, neurological growth, if repressed through sub-optimal nutrition during early development, cannot recover the losses at later stages if optimal or even super-optimal nutrition is then provided (Dobbing, 1964, 1968). In this case, the environmental factor of sub-optimal nutrition has forced the chreod for phenotypic expression of growth into a

Figure 2. Waddington's model of development in the epigenetic landscape.



Waddington's model is visualized as a ball rolling down an epigenetic landscape composed of channels (chreods). The channels represent the finite number of paths that development can take. The probability of the ball entering a particular channel is the sum of the interactions of environmental forces with the unfolding of the genetic potential. X, Y and Z represent particular outcomes (physical traits or behaviors). The ball represents the genome and the arrows represent environmental factors. Once a particular channel is entered it is essentially impossible to reverse the processes and as the channel is traversed it becomes more and more difficult to force development into an adjacent channel. (Based on Waddington, 1965)

particular irreversible pattern. Thus, if the external forces that modify chreod development are strong enough, then gross phenotypic change may be evidenced without genotypic change. Chreods exist for both morphological and psychological development of the phenotype. External forces may cause homeorhetic adjustment of both morphology and behavior.

Since the evolutionary development of chreods has arisen through natural selection for adaptation, then forces which cause massive deviation from the "normal" pathway are more likely to be disadvantageous (eg. Thalidomide Syndrome). However, if there is concommitant massive environmental change then the "new" phenotype may be advantageous or more "fit".

Waddington developed the epigenetic model from observations of fetal development in a number of organisms. Thus it was originally a physico-genetic model. The basic premises of the model, though, can be applied to other developmental systems, with due regard to differences in the systems. Thus, historico-cultural development of human groups may be explained within the epigenetic model, if due allowance is made for the differences between biological reproduction and cultural reproduction.

Epigenetics offers a paradigmatic process model of development that is easily acceptable to sociobiology. It also offers a dynamic process approach to educational systems. Thus it provides a way of bridging whatever gaps may be perceived between biological models and their data bases and socio-psycho-cultural models and their data bases.

Epigenetics has already made some inroads on educational thought through the work of Piaget (1971, 1976, 1980). Piaget developed his concepts of accommodation, assimilation and adoption as processes of cognitive development directly from the biological model of epigenetics. He accepts the primacy of the

biological premise of human development. The Piagetian model is ontogenetic in form, but in his last works (Piaget, 1980), he begins to discuss phylogenetic aspects as well.

Throughout the remainder of this dissertation epigenetics will be reiterated as a paradigm for reduction and investigation. It will exist as a central theme in the problem of co-opting sociobiology into education.

SUMMARY

In this chapter a basis for the reduction of sociobiology to education (or vice versa) has been laid. In addition, Waddington's concept of epigenetics was given as an inclusive process model within which the reductive process can be demonstrated for all aspects of development. The objective was to show that the reduction must include, at the least, the massive data bases brought to education by sociobiology.

The epigenetic model was presented as a potential model whose parameters would allow for development to be discussed in all its aspects, comparatively and concurrently. The model then provides a method for the reduction to proceed in a visual manner for all of the developmental aspects discussed later in the text.

III. SOCIOBIOLOGY AND THE SOCIAL SCIENCES

Heretofore, the major tenets of sociobiology and of the methods of empirical reduction have been outlined. Also presented was a possible model for developmental systems. The argument has been presented that changes in educational theories of learning and social development result from independent research being co-opted by education, at least in part.

This chapter will examine recent influences of sociobiology upon the social sciences as seen by social scientists. It is demonstrated here that sociobiology can and has resulted in changes in perspective and development in the social sciences. It follows, then, that these changes will be co-opted into educational systems as educators become aware of them. This argument assumes that educators will maintain their past modus operandi of co-option.

No assessment of the future course of the social sciences is implied in this chapter. It is not the purpose here to predict how sociobiology will change or direct the course of social science development. It is simply to demonstrate that sociobiology is being seriously considered by some social scientists as a "new paradigm" for the description and investigation (explanation and verification) of learning and social development. This caveat notwithstanding, some comments about the possible future course of the social sciences will be made. These comments represent only one current conceptualization of possibilities of future courses.

Since the purpose here is to demonstrate that sociobiology is capable of influencing the social sciences, little criticism is advanced concerning the views stated. There is no need to criticize how social scientists use or abuse sociobiology at this point. Such criticisms would, in and of themselves, comprise

major dissertation topics.

In the past, Watson's behaviorism, Skinner's operant conditioning, Thorndike's connections, Guthrie's contiguity theory, Gestalt theories, Lewin's topological theories and Kohler's field theories, to name only a few, have all been used as bases for theories of learning and social development. However, none of these theories has been succesful in and of itself in explaining all aspects of learning and perhaps more importantly, there has often been great dissension between theorists. This is a reasonable result, since each has emerged from a single class of experiments and usually the theories have not always been related to current information about neurological structure and function, but rather were often used to infer such structure and function. Also, there was no general paradigm under which all of the results from the above theories could be subsumed.

However, if the various aspects of these theories are subsumed under an evolutionary biology paradigm, the often conflicting results, which in the past led to disagreements, can be explained as singularities within the "grand" paradigm. In this sense the evolutionary paradigm, by relating all of the data on learning back to a selective adaptation framework, would allow us to integrate and account for many of the discrepancies within and between learning theories.

The argument being advanced here is basically that presented earlier. The failure of the social sciences to present a rigorous unified theory of developmental systems stems, at the least, from the adherence to what is, at best, a naive conceptualization of the biological basis of human behavior (Flacks, 1980; Mandel, 1979). At the other end of this conceptual continuum is the premise that biological bases can be, or are, transcended in human development. The onus passes to adherents of this view to demonstrate when transcendence occurs and also to either integrate or explain away the large protocol statement

base that has accumulated about the biological basis of behavior.

ROSENBERG AND THE PRE-EMPTION OF SOCIAL SCIENCE

The most emphatic voice in support of sociobiology from the social sciences is probably that of Alexander Rosenberg, an economist. In his book "Sociobiology and the Preemption of Social Science" he argues that the failure of the social sciences to attain the precision of nomological structure and predictability of the natural sciences stems from a failure to correctly apply empiricism.

> The present essay offers a novel account of the implications of a commitment to empiricism for the research programs of the social sciences. It does so by pursuing an inductive argument to the best explanation of why the social sciences have failed to attain the degree and the kind of success in explanation and prediction that the natural sciences have attained, in spite of the employment of broadly similar empirical methods. The argument rests on the assumption that the methods in question, which reflect empiricist presuppositions, are as appropriate to the study of human behavior as to the study of any other natural phenomena, and therefore seeks the causes of the failure in social science beyond alleged errors in method. (Rosenberg, 1980, p.ix)

Rosenberg starts from John Stuart Mills' question, "Are the actions of human beings, like other natural events, subject to invariable laws?". There are two possible outcomes to this question.

1. The natural sciences and the social sciences should employ the same research methods. This assumes that the answer is affirmative.
2. The natural sciences and the social sciences need not employ the same research methods. This assumes a negative answer.

If you accept (1), then you must assume that the "failure" of the social sciences to produce a single paradigm of human behavior lies in the improper use of empirical methodology. Conversely, if you accept (2), then you must assume that the "failure" of the social sciences rests upon the use of improper procedures.

Acceptance of (1) leads the researcher to a critical reassessment of the methodologies used. Acceptance of (2) leads the researcher to reject empirical methods and to seek alternatives. Those who reject (1) and accept (2) do so on the following assumptions:

a) human behavior is so complex that it is impossible to study it using the empirical methods of natural science.

b) human behavior is qualitatively different from the behavior of all other organisms and hence does not lend itself to analysis through empirical methods.

Rosenberg points out that assumption (1) underplays the complexity of many natural phenomena (i.e., particle theory, astronomy, molecular genetics) and overplays the recognition of the concepts use to describe social science. Although humans do show some behaviors that are qualitatively different from those of other organisms (i.e., language, although cetacean research may refute this) this alone does not exempt humans from their biological background. Piaget (1980) has also demonstrated the intense biological imperatives that act in cognitive development. The assumption inherent in Piaget's theory and language acquisition studies is that there are underlying biological invariants that may be reduced to "law-like" statements (Lenneberg, 1967; Piaget, 1971, 1976, 1980).

If (2) is true, then the question remains to be answered, "At what point in ontogeny does the individual exempt himself from his biological background?". This is a critical question for those who hold to a non-biological view of human social development and learning.

Rosenberg then proceeds to argue that the foundation of an empirical epistemological approach for the social sciences to a nomological view of man is to be found in sociobiology.

> Thus a scientific study of animal behavior (including human) should focus on the ultimate causally necessary (but not sufficient) determinants of heredity of this behavior, not because they are any more causally necessary for it, but because these variables figure in the lowest level laws there are about animal behavior; they are the narrowest natural kinds that subsume the subject matter of ethology and psychology. (Rosenberg, 1980, p.158)

He uses this argument to develop a statement about biological determinism. "Determinism" is usually used in a pejorative sense by anti-sociobiologists discussing human behavior, although it is deemed acceptable with non-human species. Rosenberg states that what we need for humans and all species are statements of "explanatory biological determinism: the thesis that scientifically acceptable explanations for human behavior are available only at the level of the heritable dispositions which it reflects or the neurological status which underlie it" (p.159). He goes on then to develop explanatory biological determinism as a method for developing nomological explanations for human behavior.

Rosenberg seems to be arguing here for the implementation of theory reduction. There is a need to recognize the inherent differences between theoretical reasoning as exemplified by classical physics and that of biological systems and quantum mechanics (Capra, 1977; Wolf, 1981; Zukav, 1979). The problems of dealing with open systems as opposed to closed systems and uncertainty (in Heisenberg's sense) mean that new paradigms are necessary. Sociobiology can provide an interdisciplinary framework upon which the physical and theoretical reduction of learning and social behavior may be built. The use of

empiricism to develop an explanatory biological determinism in the social sciences is Rosenberg's solution to the reduction problem.

VAN DEN BERGHE AND PROBLEMS IN SOCIAL SCIENCE

Wilson (1975) envisaged sociobiology as eventually subsuming the traditional social sciences by breaking down the boundaries between them. Van Den Berghe (1980) supports this view and castigates the social sciences for short-sightedness and resistance in a number of areas. He lists the following points with respect to the social sciences.

1. Resistance to Reductionism. The social sciences have resisted the view that human behavior is reducible to lower levels of organisation. This is a claim for the transcendence of human behavior.
2. Reification of the Group. Group behavior is assumed to be the level of action for human behavior and this is not reducible to individual behavior. This is in direct opposition to sociobiological theory, in which the individual is of paramount importance.
3. Dualistic Thinking. Social scientists have consistently attempted to delineate nature and nurture as separable entities. Biologists view the problem, if any, as interacting systems. Freedman (1979) sees behavior as resulting from 100% genes and 100% environment. Barash (1977) points out that, in any case, neither nature nor nurture could possibly be 0%.
4. Emphasis on Conscious Motivation. Social scientists assume that "nearly all of human behavior must be explained in terms of conscious purpose" (Van Den Berghe, 1980, p.37). Also, there is a strong view that only humans exhibit conscious purpose. This argument also leads to a transcendental view of human behavior with respect to other organisms and

hence in principle, human and animal behavior is not comparable. This last point has been given by some educators as a fundamental reason for ignoring a biological view of behavior, in spite of the work of Maslow and Piaget.

5. Emphasis on Verbal Behavior. Ethnomethodology and phenomenology equate human behavior with symbolic communication. There is a large data base that demonstrates that much of human behavior is non-verbal, that the interaction of verbal and non-verbal behavior is quite complex, and that the correspondence between human non-verbal behavior and that of other organisms is quite high (Barash, 1979; Guthrie, 1976).

6. Emphasis on Structure at the Expense of Process. "The failure of emphasizing structure at the expense of process is not unique to the social sciences, but it is characteristic of disciplines that lack a good general theory and yet seek to reduce the bewildering diversity of the world around them to a more manageable order." (Van Den Berghe, 1980, p.38). This is the essence of Rosenberg's arguments as well. However, the natural sciences started from a similar point of bewilderment.

7. Interplay of Observer and Observed. "One of the conseuqences of the Heisenberg effect in social sciences is that a theory or a prediction has the potential of bringing forth its own negation or conversely, of becoming a self-fulfilling prophecy." (Van Den Berghe, 1980, p.39). This stems from the lack of a theoretical framework. The integration of biological data comparable across species may help to leaven this intense interaction that occurs when we study ourselves. Ideologies may be much less easy to develop if the social sciences become more nomological in character. This again is in some accord with Rosenberg's arguments.

Again, in Van Den Berghe's arguments, we can see the need for a change from the classical physics view of the stepwise logic of scientific methodology that seems to have permeated the social sciences in the past. The paradigm of theory reduction as a two-fold process agrees with Van Den Berghe's critique of the social sciences. The argument for a more rigorous nomological approach to behavior is answerable, at least in part, by a sociobiological view.

Van Den Berghe then argues that one of the greatest obstacles to the acceptance of sociobiology may lie in some of the discoveries of sociobiology itself. Evolution seems to have allowed in humans, at least, the ability to practice deception to a very high degree (Trivers, 1981). This deceptive ability may act to keep us from seeing ourselves as we really are. As Van Den Berghe puts it, sociobiology "has an enormous potential for demystifying human behavior".

Briefly then, and in simplified terms, evolution works through natural selection. The environment causes the differential selection of genotypes through the survival of phenotypes. Those phenotypes that are adapted leave more offspring and/or fitter offspring than other phenotypes. Sociobiology, in Barash's words, is concerned with the adaptive significance of phenotypes, social behavior in particular. It must be emphasized again here, that adaptive significance has both a phylogenetic and an ontogenetic component. In a very subtle sense, there is a recapitulation occurring (Gould, 1972). We are, in fact, the result of our biosocial history. Sociobiologists assume, then, that behaviors are adaptive. We behave as we do partly, at least, because our ancestors behaved in particular ways that ensured their and our survival.

CAMPBELL AND EVOLUTION OF SOCIO-CULTURAL SYSTEMS

Campbell (1975) in his Presidential address to the American Psychology Association stated, with respect to Wilson's Sociobiology, that it is a "magnificent volume that every psychologist should own, even though we will want to feel free to disagree with it at many points.". Campbell made this statement because he believes that socio-cultural development in human societies is directly linked to biological bases of behavior (Campbell, 1974, 1975, 1980).

Campbell (1975) regards the development of socio-cultural systems to be, at least, analogous to the phylogenetic development of biological systems.

> In my judgement, the case for social evolution is strong enough so that psychologists should take it very seriously. In considering human behavioral dispositions, we should attend not only to the biological sources of behavioral tendencies, and not only to the person's own past history of reinforcement, but also to the culturally inherited baggage of dispositions, transmitted by example, indoctrination and culturally provided limitation on perspectives and opportunities. This cultural inheritance can on evolutionary grounds, be regarded as adaptive, and treated with respect. Note that when an evolutionary biologist encounters some ludicrous and puzzling form of animal life he approaches it with a kind of awe, certain that behind the bizarre form lies a functional wisdom that he has yet to understand. I believe the case for socio-cultural evolution is strong enough so that psychologists and other social scientists, when considering an apparently bizarre, incomprehensible feature of their own social tradition, or that of another culture, should approach it with a similar awe, expecting that when eventually understood, when our theories have caught up with it that seemingly bizarre superstition will turn out to make adaptive sense. (Campbell, 1975, p.1105).

It can be seen that Campbell makes good use of evolutionary terminology and concepts in his view of socio-cultural change. He calls his model the blind-

variation-and-selection-retention-model (Campbell, 1974, 1975). In a 1980 paper he has modified this to "even-if-blind-or-random-variation-and-selective-retention".

In this model, the attributes of human socio-cultural systems are viewed as evolving in an analogous fashion to biological attributes. Socio-cultural attributes develop randomly (blindly) and if they are adaptive they are retained. Variations on procedures that do not improve the adaptation are generally not retained. Since form and function are closely interrelated, different cultures tend to "discover" and "retain" similar attributes. Campbell (1975) uses the development of human tools and weapons as an example of continuous progress in social evolution.

However, the analogy must be treated with respect. Even though socio-cultural evolution may change in a "variation, selection, retention" mode, the methods of reproduction are not directly analogous. Socio-cultural evolution does not depend upon an analogous genetic system for the production of variation. "For example, there is no counterpart to bisexuality, and cross-lineage borrowing, precluded in biological evolution, becomes an important selective and reproductive process in social evolution." (Campbell, 1980, p.75).

Campbell's socio-cultural evolution model is directly based on a Darwinian model of evolution. That means that Campbell envisions socio-cultural evolution proceeding under similar constraints and with the exception of the reproductive phase, it is perhaps more homologous than analogous. Theory reduction, then, ought to function in Campbell's model as it does in the Darwinian model. The need for an approach similar to Bochenski's can be seen in Campbell's model.

Campbell (1980) also warns psychologists to beware of "normative biologism". This is the view that what is biologically natural is normatively good (the -- is, ought -- problem). This is the problem exemplified by Social Darwinism. Campbell makes the point that the biologically innate behaviors that include a craving for sweets, or group cohesiveness through aggression to non-group individuals and to other groups, that were adaptive in an earlier niche are not necessarily adaptive in our present niche. Extended food supplies and leisure time lead to obesity and related problems when the sugar craving is gratified. The technological development of nuclear weapons make group aggression suicidal. Thus what was biologically good (i.e., adaptive) is not necessarily good now. This is not to say that we should ignore these basic behavioral tendencies, but rather that in our efforts to control such behavior we must have firm knowledge as to where, when and how such behaviors have arisen (see also Magoon, 1978).

SOCIOBIOLOGY, ETHICS AND MORALITY

Stent (1980) characterizes the investigation of the moral nature of man as stemming basically from two antithetical viewpoints:

1. Platonic Ideals. The idealistic view states that moral behavior is a reflection of some ideal moral law that exists separate from man. Man can only aspire to such ideal morality.
2. Aristotelian Naturalism. In this view, moral behavior is seen as "a strategy for optimizing human welfare" (Stent, 1980, p.1) and that morality is a phenomenon of nature.

Sociobiology, of course, supports the Aristotelian view of a naturalistic ethic for all organisms, including man. Since man is seen as a part of natural

systems, then by extension morality and ethics have been brought "within the purview of biology" (Stent, 1980, p.1).

The problem of a biological basis for morality was held at an impasse until Darwin's work firmly placed man as part of the biological systems of the world. Darwin's theory of natural selection can be shown to operate upon both physical and behavioral systems in animals. The question then to be answered was, "Can moral behavior be shown to be adaptive?".

Sociobiology would approach the adaptive nature of moral and ethical behavior through comparative studies of animal behavior, in an attempt to show both phylogenetic and ontogenetic components. Also, if moral behavior is adaptive, organisms living under similar selection pressures ought to develop similar systems of behavior.

Acceptance of the Idealist position forces a logical acceptance of the possibility of the transcendence of our phylogenetic heritage and of our genetically constituted ontogenies. As we have seen above, such a transcendence is, at best, repugnant to those who would develop a nomological system to investigate and describe human development; in particular, it would be impossible to apply explanatory and verificatory procedures as outlined in Chapter II. An empirical stance within the social sciences demands acceptance of some form of the Naturalist position. Acceptance of the Naturalist position, as argued above, perforce must include biologically based studies as acceptable to the domain of ethics and morality.

SOCIOBIOLOGY AND SOCIOLOGY

Sociobiology is currently being used as such a paradigm by some researchers in sociology. Boorman and Levitt (1980, p.2) state that "the

(population) genetic approach to social evolution is...one of the fundamentally fresh ways of looking at problems on the boundaries between behavioral biology and social science". They are attempting to define the parameters necessary for the development of sociality amongst any group of organisms. They view the evolution of social behavior as a necessary outcome of interactions amongst organisms. Boorman and Levitt accept a complex view of the biological premise of social development.

SUMMARY

In the introduction to this chapter it was proposed to illustrate that sociobiology was having some influence upon theory development in the social sciences. Selected arguments by a number of social scientists have been given that indicate that many social scientists perceive a need for the inclusion of sociobiology or a biosocial stance. There are other social scientists who would argue against this claim.

This dichotomy in no way invalidates the original premise that sociobiology is indeed affecting the social sciences. In fact, simply by arguing for or against a sociobiological position, all social scientists are including sociobiology and allowing it to influence them.

Social sciences, in the future, in order to become a viable source of information about individual and group behavior of humans and about sociocultural evolution, must take into account the biological anlagen of these systems. Sociobiology presents one comprehensive biosocial pathway for social scientists to follow. As sociobiological research modifies our perception of the phylogeny and ontogeny of human biological and socio-cultural change, social scientists will begin to be able to create a unified theory of human development.

A more sophisticated view of reduction in education will be possible only if there is a pre-existing discipline that can provide a paradigm to subsume existing protocol data bases. Many biologists and social scientists think that a form of sociobiology may be that discipline. As sociobiology proves to be a basis for nomologic construction in the social sciences then there will follow major changes in educational research. This is based on the assumption that education will continue to take methodologies and theories from other social sciences, as it has in the past.

IV. HUMAN BIOSOCIAL DEVELOPMENT

> The important issue is not what biological behavior is exhibited per se, but rather, what is the biological contribution to the shaping of what is learned. (Hamburg, 1978, p.158)

In this chapter, selected items will be used to demonstrate:

1. a basis for a biological premise of human development and behavior;
2. some areas where sociobiological ideas impinge upon education through considerations of learning and social development.

In an overview of several aspects of development, normal developmental parameters and some effects of deprivation on that development will be described. Normal development is viewed as phylogenetically predetermined to some extent, within a genetically allowable range of variation (individual phenotypic variation) during ontogeny. The argument advanced here is that behavioral and physico-chemical development are equally and homologously susceptible to change.

The overview will form the basis of the argument that behavior results not only from gene/environment interactions that occur ontogenetically, but is also grounded in the phylogeny of the group. Biosocially, we are behaviorally constrained both ontogenetically and phylogenetically. Following the arguments in Chapter II, the argument will be extended that the claim for a transcendence of human behavior is, at best, unlikely.

Three broad instances of human biosocial development will be discussed:

1. Male/female developmental differences will be discussed in some depth.
2. The interactions of group size and development will be summarized.
3. Some aspects of visual procesing will be examined.

The rationale for this approach is that exemplars of human biosocial development are required to substantiate the claims made later. Also, there must be a diversity of exemplars to demonstrate the wide application of biosocial theory. However, it is not necessary to exhaustively catalogue all possible instances (Hadamard, 1945).

MALE/FEMALE DIFFERENCES

One of the current arguments in education is about the relative abilities of males and females to learn particular academic subjects. For example, Benbow and Stanley (1980) stated, "Huge sex differences have been reported in mathematical aptitude and achievement" (Benbow and Stanley, 1980). Kolata (1980) refutes their interpretation of the data as, at least, insufficient.

The perennial problem in the psychology of sex differences in learning has been to find measures upon which everyone can agree. Recently, the beginnings of such procedures may have begun. DeLacosta-Utamsing (1982) reported on structural differences in the corpus callosum between males and females. Since this difference is apparent at 26 weeks post-conception, it cannot be attributed to socio-cultural influences.

Since in the biological sciences structure has always been viewed as intimately related to function, structural differences imply functional differences. Thus, the manifestation of sex-influenced differentials of learning in males and females will not be manifested in something as narrow as subject area, but rather over the whole span of developmental learning and socialization as biological potential interacts with socio-cultural opportunities.

The point being made here is that reiterating the nature/nurture argument does not advance learning or social development. Accepting the biological

premise in a biosocial system can take us beyond it to investigate biosocial factors in an integrative sense. The explanation and verification of male/female differences in learning and development may lie in this approach. Therefore, there are presented here some of the biological data available and it is extended into a biosocial framework through concepts such as those of Guthrie and Beach (discussed below). The subdivision of the following material into sections is for convenience only in maintaining the ideas. In reality the integration of concepts is a biosocial integration and can no more be treated separately than can Piaget's assimilation/accommodation concepts. This inseparability does lead to some problems when discussing the data and, it is suspected, to the inability of some people to accept the data.

A caveat is entered here: there is no direct or implied argument given here that sex-related differences in behavior are in any way related to an argument for the socio-cultural superiority of one sex or the other. Sex related behavior differences are simply that: differences. There is, though, probably significant biocultural development based on sex difference (Grumet, 1980, 1981a, b).

Male Mortality

Males in all vertebrate species exhibit differential mortality with respect to females. Figure 3 shows that males are much more susceptible to mortality factors, from the moment of conception, than are females.

The differential mortality of males with respect to females can be shown to carry over into other areas, or rather is simply one aspect of a wide range of male/female differences. Males show a greater range of variation for many more attributes than females. Males die at a greater rate, but those males that survive to very old age live much longer than most females. Males score both higher and

Figure 3. Male/female differential mortality in humans.

	Males	Females
Conception	130	100
Birth	105	100
Age 20	100	100
Age 60	95	100

Number of human males alive/100 human females at selected ages. (Based on Farb, 1978; Freedman, 1979)

lower on I.Q. tests than do females and therefore have a greater standard deviation. Males have a greater number of neurological disorders and it seems, a greater proclivity to intense disorder. The "poor-baby" syndrome of the male incapacitated by the common cold may in fact have a biological basis (Beach, 1978; Hamburg, 1978).

U.S. Census records list 64 specific causes of death. Males show a higher rate on 57 of the 64 causes. Of the seven remaining factors, 5 are specific to women. One hypothesis to explain this seemingly anomalous phenomenon is the genetic difference between males and females. The XY genome of males may lead to a greater variance of sex-linked traits in males. Also, X-linked recessive alleles will be manifested more often in males who lack the dominant allele that would normally appear on the other X-chromosome. Whatever the explanation, males seem to be in greater jeopardy than females throughout their lives.

Ontogenetically Persistent Traits

At birth, males cry more, are less responsive to spoken reassurance, and require more tactile stimulation. They show more interest in inanimate, non-social objects, greater interest in problem-solving, and are more likely to attempt to dismantle toys and other objects (Freedman, 1974, 1979; Osofsky and Connors, 1979).

Bock (1973) and Bock and Kolakowski (1973) found that, in general, boys score better than girls (75% better) on tests of spatial visualization. However, biographic data indicates that female engineers were good at spatial tasks very early. In an East African study those girls who performed better on returning home after wandering, outperformed boys on spatial tasks (Freedman, 1979).

Girls, from birth, are more responsive to their mother's voice and to voices in general (Kagan, 1978). They usually speak before boys and outperform boys on

all verbal and linguistic tasks (Freedman, 1974). Kimura (1967, 1969) has shown that this functional differentiation results from sex-related differences in cerebral asymmetry. However that dominance difference is not immutable (McGlone, 1980). Problem-solving in girls can be enhanced by recasting the problem in expanded linguistic form. Tests have been devised that can favour one sex or the other, in performance terms (Freedman, 1979). This could have powerful effects in terms of evaluation in education systems.

Girls are more cuddly from birth. Girls were found to kick less, assume a more rounded shape, and to resist holding less than boys. One of Freedman's students (Blanck, 1971) observed students studying in the library of the University of Chicago. She found that:

> ...only females tucked their feet under themselves, only females typically hunched under coats, only females tended to hold their heads to one side while rounding their shoulders. That is, even when older, females tend to curl into compact spherical shapes - cuddly shapes, if you will. Males, by contrast, usually were squarely planted in their chairs with shoulders levels and head unbent. Both feet were often on the ground, with legs spread apart. (Blanck, 1971 in Freedman, 1979, p.53)

Girls smile more than boys, and respond more to being smiled at. Freedman (1979) conducted several studies on smiling, but the "cleanest" study was done on examining high school year books. Samples from 1931, 1939, 1956, 1962 and 1965 showed that a larger proportion of girls were smiling.

The data presented here indicate dichotomous trends in the behavior of males and females. These trends are cross-cultural and result from the phylogenetic interactions of genes and culture. Although there is some controversy about the relative importance of genes or culture in the interaction,

McGlone's (1980) review of the literature demonstrates both a real biological phenomenon and the need for more research at the neurological, individual and social levels. The effects of these trends upon learning and socialization are of particular importance in educational systems.

Hormonal Control of Sexual Behavior

> Over the years, it has been established that under the influence of gonadal hormones at critical fetal or neonatal periods, the mammalian brain is programmed for sex difference in characteristic mature sexual behavior and copulatory patterns. Not only is the characteristic behavioral response determined, but the threshold point is set for later sensitivity of the brain to circulating gonadal hormone levels. (Hamburg, 1978, p.171)

In fetal males and females, the sensitivity of different regions of the brain is established through the presence or absence of testosterone. In the presence of testosterone the fetus is "masculinized". The non-cyclic release of gonadotropin from the pituitary is characteristic of males. Females are characterized by cyclic release of gonadotropin, culminating in the cyclic peak of the menstrual cycle (Beach, 1978; Hamburg, 1978; Uttal, 1978; Young, 1978).

Evolutionarily, the complexity of the neuro-hormonal-environmental mechanisms that control sexual behavior has increased in human phylogeny. "Mature human sexual behavior represents a culmination of this trend and social learning appears to play a superordinate role" (Hamburg, 1978). This is in accord with Beach's (1978) model in which the social role capitalizes upon the biological basis of behavior.

Aggression

> Human aggression refers to attack or threat behavior, physical or verbal, aimed at physical injury or intimidation of another individual. In

> my view, this definition does include predatory, defence and dominance behavior. Undirected motoric or verbal outbursts or accidental injuries to others are not included. (Hamburg, 1978, p.185)

Inter- and intra-sexual dominance behavior arises from differing hormonal regimes. Males in general, due to the masculinizing effects of testosterone, are larger and stronger than females. While the dimorphism of size may be slight, that of strength is dramatic. The strength dimorphism and the vulnerability of females nurturing children has led to an historical pattern of male dominance.

Males have many co-adaptations (anatomical and physiological) that exacerbate the hormonal release of aggression. Males have greater vital capacity, slower resting heart rate, greater stroke volume, and higher capacity for neutralizing lactic acid. Testosterone promotes muscle and bone development and provides "motivational and emotional complementarity to the physiological adaptations for a hunting life." (Hamburg, 1978).

Intra- and Inter-sexual Signalling Devices

Guthrie (1970, 1976, Personal Communication) has demonstrated morphological-behavioral signals that constrain intra- and inter-sexual aggression in humans. Females have a great many characteristics that inhibit male aggression (complementarity of signal). The secondary sex characteristics of humans, in Guthrie's view, act as social signal devices, and sexual dimorphisms have been selected in humans. Females tend to have physical characteristics that are paedomorphic (child-like). Children in all cultures are socially non-threatening. By selecting and presenting paedomorphic characteristics, women then take on a non-threatening appearance.

Guthrie's view, shared by Beach, is that evolution has, through societal pressures interacting with biological attributes, selected and enhanced certain

morphological and behavioral differences between males and females. "Societies in general appear to have intuitively recognized certain male and female differences, formalized them to some extent, and incorporated them in the stereotyped gender roles of the two sexes." (Beach, 1978, p.131).

Again, in Beach's (1978, p.132) words, "Society did not create the original difference, but society did seize upon that difference and exploit it for other purposes...". The testosterone controlled aggressive tendencies of males have been societally transmuted into behavior interactions that promote male/female dichotomies.

Hamburg (1978, p.165) states that, "coercion will become the exception rather than the rule" as modern societies rely more upon legislation as a device for controlling male/female differences. However, as society becomes restructured upon legal grounds, the biological basis for the original structuring should not be forgotten. Legislation does not eliminate biological differences or their manifestations. No society has been able to ignore sex differences and new societal norms must take this into account. In Morowitz' (1981, p.137) words, "This seems a harsh conclusion, but we cannot crawl outside of our biological skins to solve social problems.".

Competence Clusters

Broverman et al. (1972) in their study of sex-role stereotypes in the U.S. identified competency clusters. The study included age, sex, marital status and education factors. Their conclusion was that there is a strong consensus across all groups as to sex roles. The characteristics ascribed to men and women are referred to as competency clusters.

Men are usually given the following characteristics:

- independent, objective, logical, competitive, active, adventurous, decisive, self-confident, ambitious, skilled in business, and take leadership roles.

Women were given different characteristics:

- dependent, warm, expressive, passive, non-competitive, sensitive and able to express tender feelings.

Generally, the male characteristics were more positively valued and both sets are uncritically accepted in the development of the self concepts of men and women. In Beach's (1978) and Guthrie's (1976) views, the development of competency clusters would result from society's covert use of sex differences through exaggeration, to produce clearly definable roles.

Dominance Hierarchies

Males form dominance hierarchies from a very early age. Freedman (1974, 1979) asked the question, "Which of you is the toughest?" of four year old boy/boy, boy/girl, girl/girl dyads of North American Caucasians, European Caucasions, Ethiopian and Nigerian blacks and Navajo Indians. The result was always the same. The two latter dyads reacted with embarrassed giggles and lack of interest. The boy/boy dyads always reacted with each boy stating "Me". While there are cultural variations in the range of aggression shown by groups, males in all groups are concerned with superiority.

At about six years of age a dramatic change occurs. Boys of this age agree on who is toughest (80% of the time). Group consensus on this agreement is very high. The dominance hierarchy forms very early in male groups with a group consensus on the hierarchy. In inter-sexual hierarchies boys are always at the top of the hierarchy, girls are at the bottom of the hierarchy, with some overlap in the middle. Within the group there is great accuracy in defining the dominant

members. That is, everyone knows who are the top ranking members and pays much more attention to them. The lower ranking members are not as well known, are paid little attention, and their rank is not as well agreed upon as those on top. These hierarchies exist in all groups of children cross-culturally.

Dominance hierarchies exist in all classrooms. Freedman (1979) reports that teachers not only did not know of the existence of these dominance hierarchies, but also did not believe in them until they were told of their existence by the students themselves.

The effects of dominance hierarchies on academic achievement, social adjustment and teachers' perceptions of children's performance, competence and progress should be investigated. Even if teachers are not overly aware of dominance hierarchies in their classrooms, they may well respond to them by unconsciously altering their behavior towards higher or lower ranking members. Freedman (1979) goes on to point out that dominance hierarchies exist throughout human life and are pervasive in their effects upon our behavior. He observes that when we converse, most of our talk is directed to and about dominants in our lives.

What factors determine the ranking of members in a dominance hierarchy? Savin-Williams (1977) investigated dominance hierarchy formation in a summer camp. The camp was co-ed for 12-14 year olds. Each cabin housed five or six boys or girls. Cabins were sex segregated.

In the boys' cabins, dominance hierarchies were usually resolved within the first hour and the system stabilized over the summer. The top and bottom boys were established within 30 minutes. The alpha males were the most handsome, most physically mature and the most athletic, as judged by the other group members. Surprisingly, they were not necessarily the biggest or strongest.

The best predictor of alpha males was their use of "verbal ridicule, verbal commands, and physical assertiveness" (Freedman, 1979, p.46). The beta male was one who got along well with the alpha. The gamma male was the bully - big, strong and disliked. The omega male was a "nerd", physically immature, short and least athletic. Nerds knew they were nerds and described themselves as being so. Nerds, however, were the most enthusiastic about camp.

The contrast with the girls is striking. Dominance relations were very slowly defined and in some cabins were still in flux at the end of camp. The single criterion of dominance was "maternal assertiveness". Girls who provided security, support and were pubertally mature became leaders. Physical beauty was not a criterion. Assertive dominance was perceived as annoying and physically dominant girls were not group leaders.

In the boys' groups the top of the hierarchy was stable. Fluctuations occurred only in the lower ranks. In girls' groups stability occurred in the lower ranks while the top ranks remained in flux.

> If this dichotomy in female leadership - the positive maternal and the negative antagonistic leaders - is characteristic of female leadership in general, it is interesting to note that in the present study the former were perceived by peers and authorities as more likeable; they were also more effective in eliciting peer support and exerting leadership, and dominance over them. The charismatic antagonists were more visual, but ineffectual in the long term basis. When they were in control, cabin life was chaotic, unpleasant and unproductive. (Savin-Williams, 1977 in Freedman, 1979, p.48)

In spite of the above comments, female counsellors "invariably selected the antagonistic girl rather than the maternal leader as the most dominant". It seems that females respond to aggressiveness as a dominance characteristic. This may

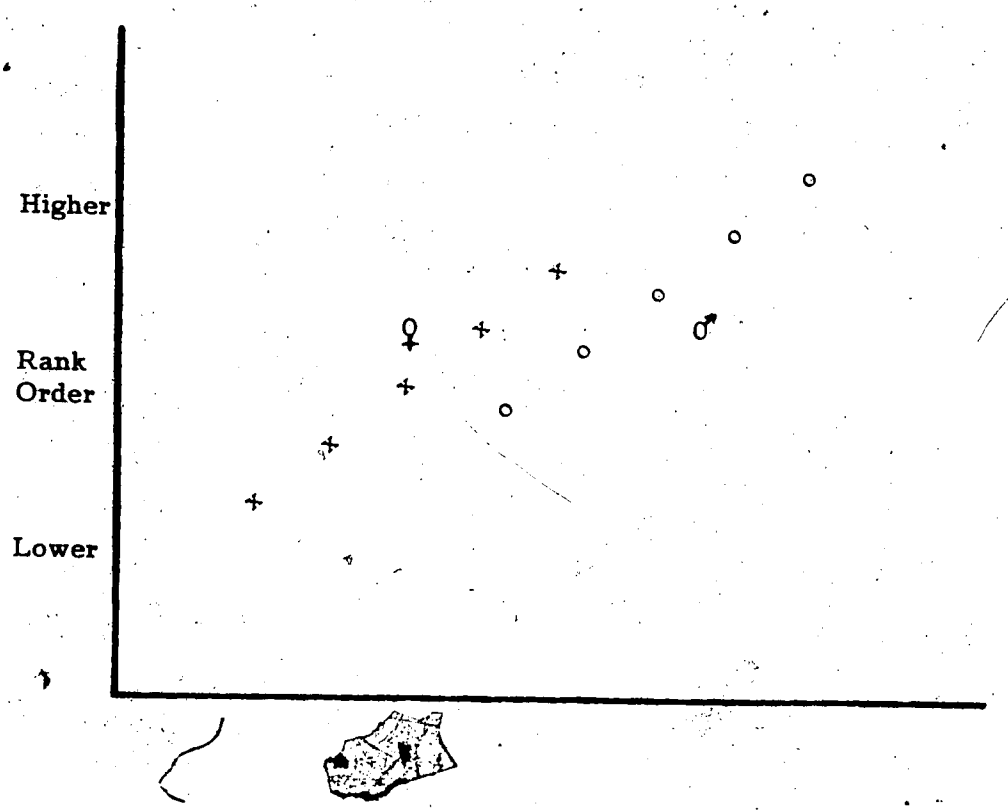
be an adaptation to the male proclivity to aggression as a dominance-submission mechanism. It also corresponds to the phenomenon of male hierarchies being, in general, dominant to female hierarchies. This is shown graphically in Figure 4.

Savin-Williams reports that the differences in the methods of establishing rank ordering of the girls' and boys' cabins can be shown by descriptions of behavior: boys are characterized by "mean" behavior, while girls are characterized by "cruel" behavior. Also, the boys' behavior in antagonistic settings was of short-term duration. Reconciliations were relatively easily achieved and few long-term grudges were seen. The girls, on the other hand, were described as "cruel and horrible" with long-term grudges and little reconciliation. (These behaviors ought to be contrasted to the competency clusters of Broverman discussed above.)

This long-term interaction interfered with the progress of camp life for girls throughout the summer. Few lasting friendships developed, and then usually only between pairs of girls. Cohesive groups did not develop among the girls with the same rapidity of strength as that of the boys. A biosocial view would indicate biologically based proclivities to differences in sex related behavior with respect to the formation of inter-individual relations in same-sex groups. These differences are in accord with data from other primates (Beach, 1978; Hamburg, 1978; Popper and Eccles, 1977; Young, 1978) and will become important in the discussions of Stanchfield's research in Chapter VI.

Freedman (1979) reports that females from same-sex classes tend toward greater self-assertiveness. Studies at women's colleges indicate that the graduates are more independent, assertive and immodest. Women's colleges produce achievers at 1.9 times the rate of co-educational colleges (Oates and Williamson, 1978). It seems that if males are restricted from the female

Figure 4. A diagrammatic representation of the overlap of male and female dominance hierarchies.



The highest ranked girls may be dominant to the lowest ranked boys. However, boys in general rank over girls. This corresponds to data for all primate groups and most vertebrate groups.
(Based on Count, 1973; Freedman, 1979).

environment, then females take on more independent behaviors. The educational aspects of this are intriguing.

> We cannot have it both ways. If we want women oriented primarily toward childrearing and male supremacy, coed schools are perhaps the best. If we want outspoken, independent women, all-female schools seem to be in order. (Freedman, 1979, p.73)

The strength of a biosocial perspective can be seen in this statement. Biosocial research does not demand a "biological determinant" that because certain behaviors have a biological base, they ought to lead to certain societal structures. Rather, the research indicates possible pathways (chreods) with a biologically determined range of potential. Society evolves by some consensus, particular behaviors within an allowable range that are more beneficial than others and biosocial structures maintain and modify them. This is the essential concept in both Campbell's (1975, 1980) and Beach's (1978) models.

The recognition of human behaviors at a covert level can be seen in the arts, which often mimic or mirror life. Television situation comedies rely heavily on universals of human behavior. The program "Happy Days" a smash hit. The male group here conforms exactly to Savin-Williams' data.

Alpha male	Fonzie
Beta male	Ritchie
Gamma male	Ralph
Nerd	Potzie

This program's popularity stems it seems, in part, from its correspondence to the biological structuring of hierarchies. We can identify with each group member. We are sure of their place and how they will act in any situation. Interestingly, Fonzie uses verbal ridicule, verbal commands and physical

Figure 5. Four lines of research and evidence for an holistic approach to the study of the development of behavior. (From Freedman, 1979)

1. We can look at very early development, especially newborn behavior, to see whether intimations of later patterns are present in this obviously unlearned and "precultural" behavior of infants.

2. We can look at developmental patterns in children to see how c[illegible] they follow the lower primate patterns.

3. We can look for world-wide consistencies in behavior, assuming a biological underpinning for those traits that are universal.

4. Finally, we can resort to experimental techniques, for example, we can modify standard psychological projective instruments in order to test evolutionary hypotheses.

assertiveness to establish and maintain his rank. It might be noted that while the women in the program are usually submissive, they do dominate periodically through nurturing behaviors. Even Fonzie bows to Mrs. Cunningham, as a mother.

What happens in Grade 1 when boys and girls are establishing hierarchies? How does this affect the teacher's response to each child? What correspondence exists between the teacher's position in his own hierarchy and his response to his students? The answer to these questions may be best approached from a sociobiological perspective, utilizing Freedman's four point paradigm (Fig. 5).

GROUP SIZE AND COMMUNITY SIZE

Humans have evolved as hunter-gatherers in direct response to environmental demands. The survival capability of any group of humans is directly related to the available resources of food, water and shelter to the availability of other humans. Anthropologists (Bicchieri, 1972; Birdsell, 1968; Steward, 1968) have identified various primary group structures in subsistence level societies. Primary subsistence bands of extended families number about 25 persons. Regional bands have an upper limit of 300-500 persons depending upon some physical attributes of the environment.

Regional bands of more than 500 are rare even if food, water and shelter are plentiful and easily acquired. The physical and psychological barriers that impede contact and communication of members in groups greater than 500 leads to fractionation of the regional band into two or more groups. The fractionation occurs as the peripheral members begin to differ in behavior and dialect. It seems that for group stability all members must have direct contact capability with all other members. If direct contact capability is impossible the group must split. This seems to be a biosocial imperative.

Birdsell (1968) discusses the problem of fractionation of the regional band as a function of dialetical homogeneity. Dialectical homogeneity is the result of direct communication. There are four factors that act in determining homogeneity or heterogeneity:

a) frequency of interaction;

b) intensity of interaction;

c) duration of interaction; and

d) facility of communication.

As frequency, intensity and duration increase among group members as a function of increasing group size then facility of communication between individuals will become more difficult. At some determining point, increasing dialectical heterogeneity causes the regional band to split.

Birdsell (1968, p.232) maintains that "the dialectical tribe seems to be independent of regional variations of density, local environment and biota, and technology". It is easy, then, to see why various ethnic or religious groups tend to maintain themselves easily in enclaves within larger communities. Similarly, the push toward community and alternative schools may be influenced by some very basic biological urge to maintain a dialectical homogeneity at some fundamental community level. Humans seem to require a sense of communal belonging. Language is a primary method of maintaining homogeneity. This is an elegant example of the complex interaction of biosocial factors in human development.

Barker and Gump (1964) found that the success of students in schools is a function of ecological setting. They found that students in high schools were most content with themselves and their perception of their place in school, in schools of about 200 pupils. As school size exceeds 200 pupils, a greater sense of isolation occurs. Students in larger schools lack a sense of community and feel that they have little or no impact on school functions.

Garbinaro (1980) has also investigated the relationship between school size and achievement. He summarizes his views as follows:

1. School size matters, especially for academically marginal students.
2. School size is not a linear effect. There is a threshold value of about 500 students, beyond which there is little or no increase in the effect.
3. Trends to larger centralized composite schools have direct implications for all student achievement, but especially for the academically marginal student.

One is forced to speculate here that the academically marginal student may be the result of large school size as well as the victim.

It is not mere coincidence that optimum school size falls in the range of regional band size. Remember that there is a high degree of genetic relatedness in regional bands. That probably aids in the maintenance of larger groups than in schools where the degree of relatedness is much less (at least in North America). It is interesting to speculate as to whether schools larger than 200 may be more functional if all of the pupils have a high degree of genetic relatedness.

Steward (1968) reports an array of typical human groups (Fig. 6). He reports that:

> Primary subsistence groups are little larger than those of the apes, but specialized functions in subsistence and child rearing have set lower limits on social groups, while exploitation of a wider environment and the kind of transportation have set upper limits. (Steward, 1968, p.33)

This is another elegant instance of the interaction of biological and sociological factors operating complexly upon human biosocial development.

There is another group that Steward has not discussed and that is the male hunting group. This group is composed of adult males and usually is quite small.

Figure 6. Typical group sizes of hunter-gatherer groups.
(Based on data from Steard, 1968)

Group	Size/Members
Matrifocal	Female + offspring
Nuclear family	Male + female + offspring
Primary band	Extended families ≠ 25
Multifamily primary band	≠ 25 - ≠ 40
Lineage based band	150
Maximum band	500

Three to five members are usually involved. Individual expertise is recognized by the members of the group and decisions are made relatively easily. In hunting situations, spoken language is apt to be more of a hindrance than a help. Visual signals coupled with a profound time/space sense are more likely to be attributes of successful hunters. This is in accord with the data on male behavioral abilities, discussed above.

Sale (1980), Farb (1978) and Miller (1978) all comment upon the size of decision-making groups. Administrative researchers have discovered that the optimum size for efficient decision-making is three to five. Any group greater than five will have a more difficult time in group consensus. As the group size increases the amount of time required for all members to give their views increases and the relative weight of any one view decreases. At some level, when the value of individual opinion is perceived by the individuals as quite small, group members will often defer to some perceived leader, rather than press their own concerns. It is a system of diminishing returns from the individual's perspective (Miller, 1978; Sale, 1980).

The degree of communication and cooperation in human groups has phylogenetically been a function of the degree of relatedness and the ease of communication. In modern western society, use of a common basic language and a very high degree of mobility has disrupted these basic features. It is notable, though, that dialects (slang) are quite common, especially among children and fringe groups. Language use by certain groups may act as a device to increase communality and coherence, to distinguish members of the group from all others and to exclude all others.

Adolescents are often the dismay of their parents in their seemingly unintelligible use of language. If dialect is used to maintain group homogeneity, it

should be worthwhile investigating the use of language by groups in and out of school settings. However, simply analysing language use and patterns will not suffice. We need to know how language use relates to formation of groups, group structure and inter-group interactions. What differences, if any, exist in "micro-dialects" in large schools? Are teachers and students functionally within the same groups in schools? If not, what are the effects of inter-group communication systems?

VISUAL PROCESSING

Our most precise perceptual ability is probably vision. We live in a predominantly visual world. Recent studies have shown that our response to physical characteristics of space and to physical characteristics of others through vision has profound effects upon our psychobiological functioning. There are upper and lower limits of scale in the visual environment that affect our ability to respond to stimuli. Interestingly, the work done by architects in ergonomics has all been done, to the best of my knowledge, on and for adult humans. In school systems there has been a scaling down of furniture, but there seems to be little or no recognition of the wider range of body size in younger age groups and the different body proportion of children at various chronological ages. A question to bear in mind while reading the following data is, "To what extent is it also true for children?".

Sale (1980) points out that the most satisfactory way to view any object is in its entirety. The human eye has certain physical characteristics that limit the size of objects that can be viewed this way. Maximum rotation of the eye above and below the horizon is 20 degrees and 40 degrees respectively; optimum rotation is 25 degrees and 30 degrees respectively. This means that 27 degrees is the

optimum vertical viewing angle. If you stand twice as far from an object as its height the angle subtended is about 27 degrees. Thus, for a two-story building the optimal vertical viewing distance is about 52 feet.

The horizontal viewing angle is about 30 degrees for each eye or 60 degrees total angle. At 52 feet the entirety of an object 50 feet long can be seen. The scale, then, for optimal viewing of objects is predetermined by the mechanics of the eye. Human environments that are designed within these perceptual limitations tend to be "more comfortable" than those that disregard them.

In open spaces there are also mechanical limitations of the eye that restrict the distance at which objects can be seen. The distance at which facial features can be recognized is about 72 feet and that at which facial expressions can be perceived is about 48 feet. Therefore, in the design of human environments the maximum distances for the width of streets is again predetermined.

Also, if street widths may be a maximum of 72 feet, the buildings according to the distance formula, would be about three stories. Interestingly, buldings of this height allow tree growth to exceed building height. This provides for natural color relief in cities.

The maximum distance at which a person can be recognized by general appearance, gait, age, sex, etc. is about 450 feet. Also, the primary colors are distinguishable within that distance. This means that the optimum length of parks and open spaces should fall within this range. Commonly, the famous vistas within cites (the Acropolis, St. Peter's, Piazza San Marco) all lie within the 450 foot range.

Based on a distance of 450 feet and the height formula, buldings could be 15 to 20 stories. The dimension given provides the most comfortable viewing

angles without head or body movement. Towns and cities in which these dimensions are used provide a secure feeling of belonging. In centres where skyscrapers are the rule, the secure feeling disappears and feelings of loss and alienation are dominant. Large modern cities are often described as cold (Dubos, 1980, 1981).

If simple visual perception can alter our emotional reactions to the environment as adults, how much more so may this be true for children? Does the design of school buildings reflect the ecological needs of children or adults or neither? As Dubos (1980, 1981) comments, we need both the open vistas and the secure feeling that certain environments provide to satisfy invariant behaviors. Dubos believes that these invariants result from our close environmental interactions phylogenetically and as such we are predilected to respond more favorably to certain simuli than others.

The emotional security of children in educational systems is probably determined at some basic biological level by the design of the system. We need a great deal of research in this area to determine what parameters are most important ecologically to promote learning in children and also how these parameters change with ontogenetic changes.

Recent evidence indicates that children from neonates to at least age five years, do not see in the same way that adults do. This is a function of the maturation of eye morphology and physiology (Cohen, Deloache and Strauss, 1979; Kowler and Martins, 1982; Salapatek and Banks, 1977). Focal distance is shorter in children, saccade time is longer, fixation time is shorter. There is a post-natal maturation of the whole visual system. The retina matures first, then the LGN (lateral geniculate nucleus), the striate cortex, etc. This is in accord with data on the developing visual system in other primates (Uttal, 1978). There is a

gradual improvement in all aspects of visual processing from birth up to about eleven years of age (Young, 1978).

The abilities of children to receive and process visual information is different from those of adults. The design of ecological systems for children then must be different than that of adults.

SUMMARY

> Unless we start with the recognition that behavior is wholly biosocial, unless we think of it as determined simultaneously by proximal and historical factors (including evolutionary history), there is no solution to the culture versus biology conundrum. (Freedman, 1979, p.145 - his parentheses)

Freedman goes on to explain that such a view results from accepting or adopting a change in point of view or in the way of thinking and that there are probably no exemplary bits of data or evidence that will prove or disprove either side. He opts for an holistic approach to the study of the development of behavior (Fig. 5). There is in this prescription the beginnings of a framework (a guide to empirical enquiry) that educators might use to reassess their own and other's research and data about learning and social behavior. This framework is explicit in Rosenberg's arguments for an empirical approach.

In summary, in this section data have been presented that link various aspects of human behavior to evolutionarily selected adaptations to previous lifestyles (i.e., hunter-gatherer) and to phylogenetic adaptations of the vertebrates as a group. Education, as a discipline concerned with the learning and social development of individuals within groups, will have to; (1) develop methods of integrating such data into its own paradigm; (2) allow other disciplines to perform such integration and hence obtain it second-hand; (3) ignore the whole issue until it is forced upon them.

The third alternative seems unacceptable to anyone who would claim a science of education. The second alternative has been used historically in education, but creates a long time lag between acceptance and implementation. The first alternative implies an acceptance by educators of the importance of the biological premise of human behavior, of a biosocial view of behavior, and of sociobiology as a discipline for philosophical and practical development. Acceptance would also put educators in the forefront of the coming changes in the re-conceptualization of educational systems.

V. BIOSOCIAL PERSPECTIVES IN EDUCATION

A PHILOSOPHICAL POSITION FOR THE CO-OPTION OF SOCIOBIOLOGY

Educational theories of learning and social behavior have been predicated upon the research of other areas such as psychology and sociology. Educators have taken theories from other disciplines in whole or in part and modified or changed them to fit the particular situations of educational systems.

Often these theories have been accepted or adhered to with little or no critical analysis of them, within their own areas, as well as their applicability to education. There is a need for an underlying paradigm of learning and social development with which they can be assessed for their applicability to education. The social sciences have not as yet provided such a paradigm.

Just as sociobiology has been shown to be an extension of evolutionary theory, rather than a radical departure (Ruse, 1979), it can be demonstrated that a biosocial view in education is not a radical departure, but rather an extension of some existing views.

Maslow (1943) has developed a theory of human motivation based upon a hierarchy of needs. The fulfillment of these needs was seen as necessary for optimum human development:

1. Physiological Needs. Food, water, shelter, etc. are seen as basic needs that the organism must satisfy, through drives, in order to survive. These needs are basic and pre-empt all others.
2. Safety Needs. Freedom from physical and psychological dangers is gained through drives that help to maintain the organism in the least threatening environment.

3. Love Needs. Psychological drives cause individuals to form relationships with others. These drives satisfy the need for interpersonal relationships.

4. Esteem Needs. There is a need for psychological stability based upon the reactions of others.

5. Self-actualization Needs. There is a last psychological need for self-fulfillment or self-actualization that will be attained only if all other needs are met.

Maslow postulated that the needs given in this hierarchy are necessary and sufficient and that except for (4) and (5) the order of the needs must be met in hierarchical order. The concept of needs and drives derives from the work of the ethologists in the 1930's, 40's and 50's.

Lorenz and Tinbergen were especially influential in developing the ethological school of animal behavior. Ethologists believed that only by studying the behavior of organisms in their natural environment could a true understanding of behavior be gained. They argued that experiments done in laboratory settings introduced artificial factors that were open to misinterpretation (Hinde, 1970).

The concept of drives that were activated by physiological or psychological imbalances in an organism, that caused the organism to engage in particular activities, was developed by the ethologists. Hunger was seen as a drive caused by the lack of food. The organism was driven to find food to readjust the imbalance. Maslow extended this concept of continually readjusting imbalances to a theory of motivation. There is a similarity here to Waddington's homeorhetic systems. Educators then picked upon Maslow's work as a model for curriculum development.

However, Maslow does not discuss how the needs are to be met or what are optimum levels. Too much food is potentially as detrimental as too little. A totally safe environment would be biologically and psychologically stultifying.

How can Maslow's need hierarchy be met in a meaningful manner? Freedman (1979) and Bronfenbrenner (1979) in their prescriptions provide, respectively, precise areas and methods for investigation that may allow us to assess the complexly interacting systems that guide human development and adaptation (see Fig. 5 p.55 above and p.73 below).

Freedman's four conceptual areas are based on his assessment of the current research in human sociobiology. They include neo-natal behavior, early developmental patterns, world-wide consistencies in behavior and new experimental techniques.

Bronfenbrenner calls for the acceptance of new procedures that include a hierarchically nested concept of the individual's environment within which it will be possible to describe systematically the properties of the interactions.

Piaget (1971, 1980) extended the concept of homeorhetic adjustment to cognitive processes. He developed a hierarchy of cognitive development analogous to Maslow's motivational hierarchy. Piaget's terms of assimilation and accommodation to describe the development of intellectual activity were borrowed from the field of development biology, along with their basic meanings. He also borrowed terminology and concepts from evolutionary biology when he extended Waddington's concept of homeorhesis and epigenesis to cognitive development (Piaget, 1971).

However, Maslow's and Piaget's theories of human development were ontogenetic in nature. Piaget (1980), began to extend his theory phylogenetically. However, this extension was not complete at the time of his death. Also, there is

almost no attempt by either author to examine the antecedents of technological cultures for explanations of human behavior. The influence of each author's cultural biases is demonstrated here. Ontogenetic development, as a culturally determined factor, was seen as paramount and phylogenetic development was considered unimportant.

This emphasis upon the cultural impact upon ontogenetic develoment ought to be compared to Hamburg's concept of biosocial development:

> The important issue is not what biological behavior is exhibited per se, but rather, what is the biological contribution to the shaping of what is learned. (Hamburg, 1978, p.158)

There is a shift here from a predominantly cultural emphasis upon the factors affecting behavior to one that includes biological contributions, both phylogenetic and ontogenetic. This shift, though, does not emphasize either biological or cultural contributions, but rather is cognizant of the complex interactions of each.

The argument advanced herein is that education has accepted the biological premise, but as trivial and essentially non-explanatory in nature, and therefore places emphasis upon cultural contributions. Both Maslow and Piaget were strongly aware of the biological premise upon which their models were erected. Educators, however, fastened upon the aspects of the models that were readily perceived as methods of implementation in educational systems.

Skinner's (in Hinde, 1970) model of conditioned behavior is a good example of a "biologically" based model that was poorly understood and applied in education. Skinner showed that all organisms could be trained to perform certain behaviors in response to conditioned stimuli.

Educators immediately attempted to apply his results to children and cognitively learned behaviors. What they often forgot was that the animals that Skinner conditioned were able to respond only within a narrow range of behaviors. The animals did not elicit any novel behaviors, only exaggerations of their normal behaviors. Thus a naive conceptualization of the results of the animal research and of the power of the technique resulted in curriculum designs that were no more effective than any others (Tanner and Tanner, 1980; Zais, 1976). It ought to be noted here that conditioning techniques are valuable for some types of learning. Military groups have known this for millenia. Arms use is best achieved through various conditioning procedures.

Educators generally have accepted a simplistic "ontogenetic" model and not investigated the "phylogenetic" components of the model. This naive co-option may be part of the reason that models such as these come and go in education.

Recently, a few authors have begun to espouse a more phylogenetic view of human development as it relates to education. Hart (1975) is perhaps the most vehement of this group. He goes so far as to say that by ignoring phylogenetic development we have created educational systems that, instead of promoting cognitive development, actually impede it. He claims that school environments, at the least, interfere with normal brain development and hence make learning more difficult than necessary.

Shepard (1973) views education as an aspect of human ecology. His view is that by ignoring the hunter-gatherer behaviors we have inherited, we have created a system of education that is anything but beneficial to children. In his view, school environments do not provide the types of experiences that the brain has

evolved to meet and hence normal development of perceptual and cognitive structures is, at least, impeded. Shepard's and Hart's concepts will be elaborated later.

These authors, prior to Wilson's "Sociobiology", were beginning to call for a more phylogenetically founded view of human learning and socialization. They advocated a view of learning that was predicated upon both the phylogeny and ontogeny of development. Thus, adaptation to both past and present environments were considered crucial factors for the design of educational systems.

Psychologists, simultaneously, were developing the field of ecological psychology (Barker and Gump, 1964; Bronfenbrenner, 1979). These researchers returned to the ethological perspective discussed above. Observing children in natural settings (schools) was seen as of tantamount importance in describing how children learn and in deciding how to modify those settings in order to optimize learning and social development. The shortfall of the Barker and Gump (1964) study is that school was seen as "natural" setting in and of itself. There has been little attempt to look at the child's total environment as a problem of interacting ecosystems.

Thus the effects of type of housing, the amount of open space, the involvement in extracurricular activities (family, church, Girl Guides, part-time employment, etc.) community involvement in the school, alternative uses for school space, parental concepts of schooling, community resource development, etc. have not been investigated concurrently in space and time as changing variables that affect children's development. The changing roles of children within various contexts in space and time are as, if not more, important in their development than the time spent "learning" in the classroom. This situation is analogous to investigating only nesting in songbirds, without considering

territorial develoment and defense, mate selection, feeding habits, ecological setting, population controls, migration, etc.

It is a relatively short step from a largely ontogenetic view of research and development to one that is both phylogenetic and ontogenetic. In the past few years a number of authors have called for a biosocial perspective in education (Campbell, 1980; Caspari, 1968; Magoon, 1978). These authors advocate sociobiology as a biosocial paradigm for extending our understanding of the development of children. Learning and social behavior have ontogenetic and phylogenetic components (shown in Chapter IV) that are influential in the ontogenetic development of the child in its new environment. In order to develop a unified theory of learning and social behavior for humans (in Barash's sense of a paradigm,) we must accept data and theories from many different areas.

Education has accepted theories from many other areas of research. Thus, in reiteration, the acceptance of sociobiology has historical antecedents. Also, the concept of underlying biological factors as influential in human development has been demonstrated for education. The extension of those views to include sociobiology, then, is not radical in any sense.

AN ECOLOGICAL APPROACH TO BIOSOCIAL ADAPTATION

In the introduction it was made explicit that the view taken in this dissertation would be towards developing middle range theory as a guide to empirical enquiry. This chapter, then, takes up that task.

Here follows a biosocial guide to empirical enquiry developed from Freedman's (1979) precepts (Fig. 5, above) following Bronfenbrenner's (1979) concepts about the ecology of human development.

Freedman's (1979) precepts provides four distinct conceptual areas for investigation. However, there is in Freedman only a brief prescription on how to go about doing research in these areas, that can then be integrated into a holistic theory.

Bronfenbrenner (1979) on the other hand, gives us a precise prescription for investigating human development from what he terms an ecological viewpoint. He has conceived of three levels of environment that are nested one inside the next. The innermost level (microsystem) is the immediate environment of the developing individual. The middle level (mesosystem) describes the relations and linkages between microsystems in space and time. The outermost level (exosystem) consists of settings and events that affect the development of an individual, even though the individual is not present. Thus the home, classroom, office, store, etc. form microsystems. The mesosystem can be envisaged when one considers home settings and their influence on classroom behavior and vice versa. The exosystem could be considered to be the effects of curriculum development committees on individual classrooms and the development of individual children within the various social groupings of the classroom. Bronfenbrenner views these three levels as complexly interrelated systems. The complex of nested, interconnected systems is viewed as a manifestation of overarching patterns of ideology and organization of the social institutions common to a particular culture or sub-culture. Such generalized patterns are referred to as a macrosystem (p.8).

It can be seen here that Bronfenbrenner has established a guide to empirical enquiry in which:

> ...by analyzing and comparing the micro-, meso- and exosystems characterizing different social classes, ethnic and religious groups, or

> entire societies, it becomes possible to describe systematically and to distinguish the ecological properties of these larger social contexts as environments for human development. (p.8)

Bronfenbrenner maintains that the behavior of any individual in any ecological setting is a function of the individual's role in that setting. Role is defined as "a set of activities and relations expected of a person occupying a particular position in society, and of others in relation to that person" (p.85).

A role holder has to meet "role expectations" about how to act in any situation. These expectations, which define relationships between the individual and all others, are controlled by three parameters: "degree of reciprocity, balance of power and affective relations" (p.85). The effects of role expectation in the above terms can be seen by contrasting the relationship of parent and teacher toward the child. Degree of reciprocity and mutual affection are presumably greater for parents and parental authority is usually wider in scope than the teacher's. However, both parent and teacher enjoy high levels of all three parameters.

The problem that faces every individual and, perhaps more importantly from the educational view, that faces every developing child, is the need to assess and define the role expectation demanded in each microsystem. Thus the changes in the functions of reciprocity, power and affectation between the parent and the child at home and the teacher and child in the classroom are fundamentally different. Another change or series of changes occurs in the playground and so on for each microsystem.

The expectations and responses of children analysed "simply" in terms of hierarchical situations are in a constant state of flux. Definition and re-definition are constant constraints upon cognitive and affective behaviors.

Reciprocity, power and affect are factors considered by biosocial researchers as of particular importance in defining inter-organism behavioral dynamics. In Chapter IV the discussions on dominance relations and sex differences were essentially analyses of biosocial predilections to certain aspects of reciprocity, power and affectation. A developing child's relationships to family members, peers of either sex and extra-familial members may be considered to be functions of the child's perception of his own role and that of his perceptions of the roles of others. Since the perception of others and self is a biosocially determined function, Bronfenbrenner's conceptualization of the importance of adaptation to various ecological systems and the transitions between systems becomes a powerful approach in biosocial research.

Bronfenbrenner distinguishes his ecological studies as "development-in-context" as opposed to traditional psychological investigations which he refers to as "development-out-of-context" (p.21). Thus,

> the understanding of human development demands more than the direct observation of behavior on the part of one or two persons in the same place, it requires examination of multiperson systems of interaction not limited to a single setting and must take into account aspects of the environment beyond the immediate situation containing the subject. (p.21) (his emphasis)

It can be seen from the arguments presented, that in education the traditional approaches to curriculum development, school and classroom design, and individual development has been almost exclusively at the microsystem level. Educators have tended to see the educational system and its sub-systems as, in some sense, independent of the rest of the child's environment. At least, this is true from the research standpoint. Thus, the Barker and Gump (1964) studies on

school size investigated only the effects of absolute school size and did not take into account family or community as part of the individual's group. Similarly, all research on class size as a factor in cognitive development has isolated the microsystem from other settings in which the child might be found. It is not surprising that, for this reason alone, research on the effects of class size are totally inclusive (Glass and Smith, 1978; Porwoll, 1978; Ryan and Greenfield, 1975).

Since traditional educational research has usually ignored other microsystems it follows that it has also ignored the transitions that occur as the child moves from microsystem to microsystem as well as the mesosystem effects of linkages and interactions. Bronfenbrenner (1979) sees the transitions that occur as the child moves between microsystems as critical aspects of psychological adaptation in human development.

> I shall argue that every ecological transition is both a consequence and an instigator of developmental processes. As the examples indicate, the transitions are a joining function of biological changes and altered environmental circumstances; thus they represent examples par excellence of the process of mutual accommodation between the organism and its surroundings that is the primary focus of what I have called the ecology of human development. (p.27)

In this statement, Bronfenbrenner comes to a view that is similar to the biosocial interaction hypotheses of Guthrie (1970, 1976) and Beach (1978) set forth earlier in Chapter IV.

There is then, in Bronfenbrenners' concepts of human ecology, a methodology that allows us to investigate the complexly interrelated factors of biological, psychological and sociological develoment that contribute to the

development of individuals in particular ecosystems. Also, we can, within this framework, evaluate the effectiveness of various ecosystems in the development of certain traits that manifest themselves. Just as it is now known that nutritional deprivation can have longlasting and even permanent adaptive effects, it is becoming evident that certain types of psychological settings also can have longlasting and perhaps permanent adaptive effects. In education, therefore, it is important to know what parameters affect the develoment of children in all possible microsystems and how these interact at the mesosystem and exosystem levels.

Since education is a public endeavour in which the child receives influences from and at the micro-, meso- and exosystem levels, it has become partly a matter of public policy. In Bronfenbrenner's terms, "Public policy is a part of the macrosystem determining the specific properties of exo-, meso-, and microsystems that occur at the level of everyday life and steer the course of behavior and development" (p.9). Thus, there is a need for a reciprocal interaction between research at the basic level and policy determination at the public level. This reciprocal interaction is necessary for the implementation of research findings at all three levels, in order to assure that optimum course of development as defined (covertly) by culture at the macrosystem level. At this point then, a model is required to assess the reciprocal interaction of basic research findings at the microsystem level and their application at all levels as an expression of macrosystem level decisions.

A MODEL FOR ASSESSING CO-OPTION

Long-term research programs ought to be initiated to discover how human behavior variants and invariants are operative in learning and social development

and how ecological setting acts in shaping chreods. There needs to be a defined relationship between theory development and applied research with respect to educational theory. Unless such a relationship exists it is very easy for researchers in each area to ignore or to misinterpret each other.

Morrison (Personal Communication) has developed a model to define the dimensions of this interactive relationship in psychology. This model is very general, and presumably is functional for any area with both a theoretical and applied level of research. The five items that Morrison uses to assess interactions between basic and applied research are given below.

1. Methodological Fit. Methodological advances in basic research allow for a clearer perspective of the phenomena by the elimination of confounding variables. This leads to more rigorous definition of function, development and assessment.

2. Extensivity of the Data Base. Quality of data is directly related to quality of methodology to the extent that quality data relates to theory development. As the extent of the data base increases and as the quality of the data base increases, the ability to evaluate competing hypotheses increases (in sensu Bochenski). Applied researchers can select from competing hypotheses on the basis of data from basic research.

3. Development Timetabling (Milestone Charting). Basic research develops the timing of critical periods and development timetables. This may lead directly to assessment and application by applied researchers.

4. Development Theory (Framework). Basic research provides data for theory development. Theory development leads to hypothesis formulation about applied problems and also points the way for further basic research.

5. Match/Mismatch of Abstraction Levels. As the match between basic and applied areas becomes greater the easier it is to relate theory to applied problems. If the relationships between theory and applied problems becomes looser (mismatch) the less likely that basic research is of high quality with rigorous definition. However, mismatch does provide indicators for the thrust and direction of basic research.

In Morrison's view, a simple method of evaluating the potential impact of basic research on applied problems is to ask how many of his items are met. Is there a large data base with rigorous definitions that are related to a strong theory with a higher degree of match? Then basic research is probably very applicable to applied problems. However, he does caution that Items 1 through 4 are listed in decreasing order of reliability in making a basic/applied breakthrough. Thus, if the data base is poor, then theory development is likely to be weak.

If sociobiology can be shown to meet Morrison's criteria for the interaction of basic and applied research, it will certainly strengthen the argument that sociobiology is useful as a base for theory develoment for education.

1. Methodological Fit. Sociobiology does provide a clear perspective for discussing human development. It has both a phylogenetic and ontogenetic component and it integrates data both inter-specifically and inter-culturally. It also provides rigorous methods for research on development in cognitive and social areas (see Chapter II).

2. Extensivity of the Data Base. The data base provided by sociobiology is immense. It extends across species and through species and organism timelines. The quality of the data base is very high and is based on a

rigorous methodology. Direct relations between the data base and applied problems can be made in the form of testable hypotheses (see Chapters III and IV).

3. Development Timetabling. Basic research in sociobiology has demonstrated the existence of critical periods and developmental timetables inter- and intra-specifically. It has also shown that cognitive and social periods and timetables have a biological basis that is open to empirical investigation (see Chapter IV).

4. Developmental Theory. Basic sociobiological research has resulted in a theoretical base that is potentially useful in describing the necessary and sufficient conditions that influence the behavior of developing organisms. This allows for the direct relationship to the formulation of hypotheses about applied problems in cognitive and social development (see Chapter IV).

5. Match/Mismatch of Abstraction Levels. There seems to be a very high degree of match. Sociobiology provides a potential meta-theory that can be utilized by theorists and by applied researchers. Thus, basic researchers interested in global aspects of learning or social development can use sociobiology as both grand theory and middle range theory. Concurrently, those interested in applied problems of learning on social behavior in classrooms or schools can use sociobiology as a basis for developing testable hypotheses (see Chapters II, III and IV).

It has been demonstrated that sociobiology meets all of Morrison's criteria for establishing an interactive relationship between basic and applied research. Sociobiology ought, then, to provide a powerful meta-theory for relating basic and applied research in learning and social development in general, and as it applies to education in particular.

THREE BIOSOCIAL MODELS OF SCHOOLING

In the preceding sections there have been presented selected data about sociobiology and the relationship of sociobiology to mainstream biology and to the social sciences. The data perforce was selected since the enormity of the data base precludes an exhaustive cataloguing. This selectivity notwithstanding, the preceding sections were designed to provide the basis for developing a biosocially based conceptual framework for educators with which they may view and review learning and social development theory.

The intention here is to extend the conceptual framework as a guide to empirical enquiry based on the foregoing and upon preliminary assessments of biosocial education as expounded by Hart (1975), Shepard (1973), and Stephens (1967). This will be accomplished by integrating their individual concepts into a fuller discussion of human development as a dynamic process in both the phylogenetic and ontogenetic senses. The conceptual framework will necessitate a change in the thinking of educators with respect to the child as a homeorhetically developing organism, and with respect to the role of the educator in the dynamics of the child/adult relationship. This obviously has implications for the way one views the place of public education in society and also its structure.

Stephens (1967) identified a number of frivolous, playful, result-getting tendencies. These tendencies, he claims, are common to primates and humans of all ages. Stephens lists the following broad categories of tendencies:

1. Manipulative - included in human behavior are making marks, word patterns, numerical relations, changing relations of objects temporarily or permanently. Isaacs (1982) would include carrying and sharing of food and individual travel.

2. Communicative - spontaneous descriptions of ideas, objects, etc. of importance to a particular individual. No attempt is made to instruct the listener.

3. Expressive, evaluative - to applaud or comment on activities of others.
- to show disapproval or spontaneously correct the activities of others.
- to supply answers.

4. Moralizing - to call attention to the results of a course of action - "I told you so!".

5. Toleration - clusters of tolerations or inhibitions exist so that those with excessive tendencies can exist within a group.

Stephens holds these tendencies to have evolved in the primates, at least, and suggests that from these tendencies a form of spontaneous "schooling" has arisen as a set of adaptive processes. Schooling is defined as the interaction of concerned adults with nonbiologically related children such that the adults do not have immediate, continuous, urgent concern for the children, such as parents have. As children mature and the need for the immediate concern of parents is reduced, the need for more remote, sporadic, indulgent concern of others (than parents) increases and schooling becomes a necessary part of survival. Stephens believes that these tendency clusters have evolved to meet the survival needs of group oriented primates and especially humans. He also stresses that his concept of schooling applies in any human society as opposed to the western concept of school. Fishbein (1976) espouses a similar view based upon a critical analysis of primate evolution.

Magoon (1978) has juxtaposed Stephens' ideas of tendencies with some of the concepts that Wilson (1975) discusses (Fig. 7). It is evident that Stephens' and Wilson's ideas are in some agreement. Magoon envisions the sociobiological

Figure 7. A simplified view of Magoon's comparison of Stephens' Tendency Clusters and Wilson's evolution of sociobiological traits. (With additional references.)

Tendency Clusters Stephens 1967	Evolved Social Behaviors Wilson 1975
Manipulative	a) Play b) Tool Use
Communicative	a) Biological communication (body language) Lenneberg (1967) b) Meta communication Guthrie (1967)
Expressive-Evaluative	a) Social codes - indoctrination b) Rituals - role playing
Moralizing	a) Ethics - biological bases Stent (1980)
Toleration of Others	b) Reciprocal Altruism Stent (1980)

premise as one that will provide a basis for examining competing hypotheses about cognitive and affective development.

In Magoon's (1978, p.9) words:

> The Wilson proposal should certainly lead to serious and systematic reassessment of Stephen's almost forgotten case for schooling-as-the-species-insurance premium. It should also give educational researchers pause to consider whether other supposedly competing explanations or models of the instructional process are incompatible with such an evolutionary account. Subsequently, the viability of a carefully developed list of competing explanations could be tested, and those that failed to work could be eliminated. One example of such competing explanations is, of course, that subtle compensating interactions obscure treatment effects; and other major metaphors for studying the instructional process are Chomskian deep structure, and mind-as-an-information-processing computer.

Shepard (1973) discusses the ecological/evolutionary history of man as a central factor in the development of culture. He views learning as predetermined by ecological relationships that have a phylogenetic basis.

> I believe that every child under ten has three ecological needs; architecturally complex play space shared with companions; accumulative and increasingly diverse experience of non-human forms, animate and inanimate, whose taxonomic names and generic relationships he must learn; and occasional and progressively more strenuous excursions into the wild world where he may, in a limited way, confront the non-human. (Shepard, 1973, p.267)

Shepard's view is that our hunter-gatherer history has shaped our ways of learning and knowing, placing constraints on what can be learned and when it is optimally learned (Hinde and Stevenson-Hinde, 1973). Thus, by utilizing methodologies and activities that capitalize upon these constraints and

predilections for what and when, we can enhance the learning of process skills. The predilection for classification and sorting that leads to generalization can be enhanced by creating environments that support those skills. This leads in turn to the development of life-long skills. "Taxonomic training establishes a framework into which the accumulated encounters with the non-human can be fitted in an orderly way, making possible mature confrontations with the new and unknown." (Shepard, 1973, p.268; see also Hinde and Stevenson-Hinde, 1973).

Play and diversity of experience (perceptual and cognitive/affective) are seen by Shepard as the prime determinants of learning and that these are necessary for functional development. The invariants that underlie human behavior (discussed in Chapter IV) ensure that whatever the environment places within the receptive fields of a child will be, in Piaget's terms, assimilated and accommodated. For Shepard then, the educational process is one in which ontogenetic development is constrained by phylogenetic processes. Stephens and Shepard would agree that learning and social development cannot be abstracted from the proclivities of biological development without dire consequences. Shepard gives the following prescription for curriculum development.

> Children between ages six and twelve should, then, be more or less continuously engaged in an accumulative taxonomy and in the study of anatomy and physiology. Other kinds of life-science should be included, especially natural history. No aspect of science that involves invisible entities or abstract symbols should be learned at this time. The great middle ground of the sensual - the visible, audible, tangible - is the landscape of mental growth of the child. To teach him mathematics is to create a world of abstractions; he will forever be unable to see the distinctions among things themselves. He should learn to read but his reading should be circumscribed and limited, so that he does not confuse words and symbols with the things for which they stand - and to save his

> eyesight, which suffers permanently from too much artificial light, flat surface and close-up use. Instead, as a school child he should meet and explore biology, geology, languages, geography, astronomy, oceanography, soils, and perhaps certain social sciences. He should know nothing of chemistry, mathematics or physics until he is finishing his second decade of life, except what he picks up informally. The study of documentary history should be delayed until his third decade. Every child should become as expert as his nature allows in the use of his hands in gathering and preparation of materials, and in making useful objects from wood, stone, clay, leather, paper, bone, metal and other materials with hand tools. He should spend time cooking and caring for younger brothers and sisters.
>
> The child's relationship to art is a difficult matter. The child should be protected from cultural relativism and culture-bug adults. Before twelve he should draw, dance, make music, weave, sew, mimic, sculpt, and make pots, but he should be insulated from art history, and works of great artists and never go to museums. (Shepard, 1973, p.268-69)

Hart (1975) has developed a theory of brain functions (Proster Theory) based upon a phylogenetic/ontogenetic model of brain evolution, structure and function. Proster is a neologism formed from the words program structure. Hart coined the term to free the concept of older pejorative connotations.

Prosters are analogous to computer programs. They are "programs grouped in bundles of alternatives" (Hart, 1975). In a sense, prosters are analogous to Waddington's chreods. As programs develop in the maturing brain they determine the direction and the types of cognition that are "allowable". Thus, the inclusion of particular prosters necessitates the exclusion of others. In general, we learn only one language during a critical period. Other languages are increasingly difficult to learn afterwards (see also Young, 1978).

As prosters develop, they may do so independently. As prosters interconnect, a basic organization of reality appears. Thus, Proster Theory is an attempt to provide a simple inclusive organizing principle that provides a "best fit" for the accumulated data on brain development, learning theory and social development. In this sense, Proster Theory is an inclusive process model of cognitive processes. The theory is based in evolutionary explanations of structure and function.

Hart summarizes Proster Theory in the following manner:

1. Unity. There is one basic organizational mode for the brain; hierarchically organized prosters. It should be possible to explain all brain functions within this mode (i.e. memory, information processing, cognitive development, learning, etc.).

2. Availability. The brain can only utilize the prosters that are available at any instance. New programs can be created from new input. Generally, one can only do what one has learned. Since no person learns what another learns, no two persons have identical prosters.

3. Foundations. All prosters must and can only be built upon existing prosters. This leads to a canalization of hierarchical prosters. Input that cannot be organized into an existing proster is not usable. This is similar to Piagetian assimilation and accommodation. Some prosters are present at birth and are the result of phylogenetic adaptation. As prosters become elaborated through connection, cognition increases.

4. Connection. When two or more prosters, previously unconnected, become connected, sudden increases in cognition occur. This results from input of new data and a continuous search process that attempts always to integrate new data. Data must be addressed to the proper proster. As repeated inputs occur to the same address a pattern is established.

5. Rutting. Addressing tends to form ruts in thinking. Program selection does not. Insightful learning occurs when prosters link. Linkage does not occur if input is rutted. The acceptance of old input into new or different prosters avoids rutting.

6. Change. Variation in the selection of prosters is affected in two ways: (a) a new point of view (a bias) will significantly change our perception (selection of a new proster); (b) environmental shifts may abort a particular proster. Flexibility to changes in environmental change is a key to creative thinking.

7. Threat. As threat increases, the likelihood of more primitive programming (well developed prosters) occurs. Conversely, as threat is decreased, confidence increases and higher cortical functions and new prosters are engaged. Phylogenetically and ontogenetically earlier behavior is more likely to occur in stressful situations. Increasing stress inhibits higher cognition. This view is shared by McLean (1978) as well (Note 2) and Young (1978).

8. Search. Prosters carry out their programs independently, without conscious monitoring. Searching for connections is affected by (a) strong and specific input, (b) disengaging attention, and (c) avoiding stress. The brain solves problems best when they are not consciously thought about.

9. Mode. Thinking is faster, more accurate, effortless and reliable in particular modes. The most natural thought mode is PAC (perception, analysis, choice). PAC thinking is intuitional and subconscious. It is the type of thinking that we all engage in most of the time. The logico-deductive or inductive mode that we emulate as high level thinking is symbol selection and manipulation (SSM). This involves directed overt

cognition. Few people engage in SSM thinking at any time or for any length of time. Schools stress SSM thinking at the expense of PAC thinking.

10. Totality. The brain functions as a whole. Its output is the result of the total in-built schemata, stored input and the summing of biasing, rutting and both PAC and SSM. No part of the brain functions in isolation from any other part. No proster is completely isolated from any other.

Hart believes that Proster Theory can account for all types of brain functioning and that it can be used as a model for education. His model is predicated upon behavior as a measure of brain structure and function. He discusses, in brief, the environmental conditions that constrained the development of the brain, and briefly discusses environmental conditions that might be best for the optimal development of the brain.

Hart's model of brain functions is powerful, but he has not extended it sufficiently for educators to make use of it in developing environmental parameters in educational systems.

Stephens (1967), Shepard (1973) and Hart (1975) have all contributed key concepts to a conceptual framework that helps to describe the dynamic system of the organism-environment interaction. However, while each point of view or model has necessary elements, none of the models is self-sufficient as a descriptor of human learning.

INTEGRATION

Each of the three authors discussed above has taken a biosocially based stance on factors that they perceive to be influential in learning and social behavior. Stephens' view arises from a psycho-anthropological background;

Shepard's from an ecological background; and Hart's from a neurological background. While each of the authors is aware of the intricacies of their views, they tend to promote a particular biological stance at the expense of all others. Thus, Stephens promotes psycho-social parameters as the most important, Shepard feels that ecological parameters are paramount and Hart stresses neurological development. However, what is needed is a holistic synthesis of each of these factors as equipotential in a complexly interacting system.

Chapters I and III briefly discussed the roots of sociobiology as stemming basically from evolutionary theory, ethology and ecology. The sense of evolution as a vital factor in the development of human behavior is not evident in the writings of all of these authors, although, to be sure, all three would espouse an evolutionary stance.

Stephens' theory suffers from a lack of protocol statements from which to develop a rigorous system (see Chapter II). It does, however, provide a guide to empirical enquiry, and suggests where to search for protocol statements. It draws attention to certain types of observations and experiments. Stephens has isolated universal tendencies in primate developmental behaviors that are worthy of further observation and elaboration.

Shepard's theory is more directly based on a foundation of protocol statements. Ecological theory is now a valid basis for investigating human development both phylogenetically and ontogenetically. Since ecological theory exists, it can help direct attention to ways of generating new protocol statements. Shepard, in conjunction with Stephens, then, provides a sense of where and how to investigate human behavior.

Hart's theory is based on a very large protocol statement base. The bases of neurological development and functioning have advanced tremendously in the

past few decades. This sort of structure/function analysis can be studied both phylogenetically and ontogenetically. Adding Hart's theory to Stephens' and Shepard's reinforces the data bases and increases the potential scope of research.

The synthesis of the theories of Stephens, Shepard and Hart would begin to satisfy Bochenski's (1965) criteria for good science and Morrison's cr[illegible] for matching theory and application. The need for a large protocol statement base that can be used to generate laws and then theories in a cyclical manner is met by utilizing the three theories in a holistic sense.

Referring to Morrison's model of developmental dimensions (p.76 above) we can see that the first four items are well represented by various aspects of the three theories presented here. Also, in the fifth dimension, which is the most critical, there are the beginnings of a greater degree of matching.

The Stephens, Shepard and Hart theories may also be integrated as data bases within Bronfenbrenner's (1979) concepts of human ecology. While the studies that have contributed to the theories of Stephens, Shepard and Hart have not always been carried out in strict adherence to Bronfenbrenner's (1979) criteria, the data can be used to corroborate theories of development.

Psychological adaptation to particular and to changing ecosystems underlies Bronfenbrenner's premises. This can be considered to be one aspect of a biosocial continuum of factors that are complexly interrelated and that are influential in chreodic development. The highly abstract data base of neurological structure and function in ecological and ethological terms can now begin to be related, through the concept of adaptation by natural selection. Educational researchers now have a biosocial paradigm based on an eco-evolutionary view of individual and societal development that may allow for the development of a new, unified theory of learning and of social development based on the biological premise of human development.

Freed of the need to resort to transcendental claims for the development of social/cultural development, researchers can concentrate on the search for universal processes of human learning and socialization. Freedman's (Fig. 5, p.54 above) four point research program becomes viable in this sense. Flowing from protocol statements, through hypothesis and law making to theory development and back (much in the manner of the development of a fugue) means that researchers must be constantly aware of all levels of the empirical approach.

Let there be here no misconception that there will be some final unified theory. At best, all theory is only a better or worse approximation of the truth (Bronowski, 1977). However, no theory which excludes any large number of protocol statements or which refuses to investigate hypotheses can claim to explain the phenomena under discussion. Therefore, this does not constitute an advocation of some final state of human development, but rather only the development of more unified theories based on the biological premise of human development.

Biosocial theory promises to help integrate the large data bases of seemingly disparate areas. The promise also implies an increased understanding of the outcomes of complex developmental chreods in various ecosystems.

VI. EXEMPLARS OF A BIOSOCIAL PERSPECTIVE IN CURRICULUM

In this chapter discussions of three examples of biosocial approaches to various aspects of learning are presented. Each example represents one level of Merton's (1968) concept of theory development. Grumet's work which corresponds to Merton's "grand theory"; various instances which correspond to "middle range theory"; Stanchfield's research which to "practical application". None of the work presented explicitly states that it is biosocial in its context. However, it is evident that the work is, in fact, from a biosocial perspective.

It will be noted that at the "grand theory" and application level, particular researchers are cited, while at the "middle range" level a number of instances are given. It is inherent in the definitions of the three levels that this should occur. Grand theory and application by their very natures are undertaken and associated with individual efforts. This is not to imply that other workers are not influential in the development of these two levels. However, middle range theory, by its nature, tends to be integrative of the work of many researchers.

The intention in this chapter is to show how biosocial perspectives can be used in educational systems to re-examine and redefine the context of development at all three of Merton's levels. Since none of the research reported purports to explicitly utilize a biosocial paradigm, it will become readily evident that the inclusion of data such as that given in Chapter IV into such work will greatly advance our understanding of developmental systems.

Sociobiological data support the premise that the development of behavior and learning is different for males and females. The problem has arisen in education that, although those differences can be demonstrated in the sense discussed in theory development in Chapter II, there is a feeling that unless a

statistically rigorous development of sex-related differences can be demonstrated that they are not important. It is probable that something as complicated as the biosocial interactions that determine male/female proclivities does not lend itself to simple statistical analysis (Elsasser, 1975; Williams, 1956).

Bronfenbrenner's (1979) call for heuristic processes is, at present, very reasonable for analysing those male/female proclivities. No one can deny the difference in anatomical and hormonal regimes, secondary sex characteristics, brain functioning and behavior. The question is to what extent these differences affect cognitive development and the development of social behavior (see Hamburg's assertion, p.38). Also, to what extent can cognitive and affective behavior be influenced by accounting for and accommodating sex-related differences in behavior? Beach and Guthrie believe that male/female roles result from society's covert selection of both biological and social attributes. Covert selection of environmental and social factors may allow for much more powerful intervention in development of educational systems.

The biosocial paradigm implies curricula that capitalize on sex-related differences to produce material and procedures that will enhance learning for both males and females at all stages of development. This would assume greater importance at various critical stages. The formation of dominance hierarchies at about age six and the onset of puberty at about age 12-14 are especially critical times in behavioral development. The present curricular designs do not allow for these changes nor for the interactions that occur.

The argument made here is not for the superiority of one sex or the other in particular cognitive or social skills, but rather, that the full potential of males in cognitive and social skills is reached through different chreods than are those of females. Thus, to treat both sexes as behaviorally equipotential is

unreasonable. It follows that the assumption that a particular process or method is equipotential when teaching males and females is also unreasonable.

CURRICULUM THEORY FROM A BIOSOCIAL PERSPECTIVE: GRAND THEORY

Grumet (1980, 1981a, b) in a series of papers, has presented a bio-psycho-sociological rationale for the historical development of North American public education as biased towards the promulgation of biosocially defined masculine epistemologies. In these papers she traces the history of women in education as a socio-cultural process and the development of separate masculine and feminine epistemologies as outcomes of biosocial processes. The differential use of these separate epistemologies is seen, in turn, as being responsible for the particular masculine focus of curriculum throughout educational development.

Grumet (1981) traces the advent of women into the teaching profession and calls this the "feminization of teaching" (p.165). However, she dramatically illustrates that those women who entered education were forced to forego feminine virtues, such as nurturing, loving, that flow from the mother/child dyad (although these virtues were publicly praised) and take on masculine values.

> The femininization of teaching became a form of denial as the female teachers in the common schools demanded order in the name of sweetness, compelled moral rectitude in the name of recitation, citizenship in the name of silence, and asexuality in the name of stillness. (p.174).

The use of women as teachers occurred as a result of a social shift from agriculture to manufacturing at the same time that immigration increased. It was recognized that women could work for salaries that were half as great as men. This freed men to enter other professions, most of which were closed to women. Even women extolled the use of women in order to decrease the cost of education.

There was, with the shift from agriculture and the home as the educational centre, to industry, a perceived need for common education. Industrial workers needed to be able to count, tell time, be punctual, do boring tasks for long hours, accept an artificially imposed regimentation. Natural cycles have little or no place in the factory.

This necesitated a shift in the point of view of the citizen and the child. Grumet (1981) quotes Nassaw (1979, p.77),

> The parent is not the absolute owner of the child. the child is a member of a community, has certain rights, and is bound to perform certain duties, and so far as these relate to the public Government has the same right to control over them, that it has over the parent.... Those children should be brought within the jurisdiction of the Public Schools, from whom, through their vagrant habits, our property is most in danger, and who, of all others, most need the protecting power of the State. (p.171)

This quote is from the 1853 Boston School Committee. It can be seen that the government is explicitly intervening in the parents' privileges over the child. Such a statement can be found in virtually all school acts. There is in this an inherent attitude that follows logically from the reification of the "state". Although the state is only supposed to represent the consensus of the majority of the citizens, those few who hold power, elected or otherwise, are able to promulgate their particular views as those of the "state" for the "good" of all citizens. As power becomes more and more centralized, it becomes easier and easier for the State to act.

Thus the child becomes a chattel of the state to be trained by the state for his/her place within the social order. Young women are given the role of trainers within the state developed and controlled training system (public education). But

the state is run by men who have masculine epistemologies and hence the schooling system comes to reflect those epistemologies. In this sense at least, education has never been feminized.

The questions become, how do masculine and feminine epistemologies arise and what are their characteristics? Also, what is their relationship to curriculum development?

Grumet (1981a,b) suggests the mother-infant dyad as "the primordial subject-object relationship" (p.6). However, since she maintains that the relation of male and female infants to the mother is different and more importantly that separation of each from the mother entails different processes respectively, then separate male and female epistemologies arise as a result. The mother's relationship to the child is symbiotic and enhanced by the intimacy of the relationship (pregnancy, parturition and lactation) while the father's relationship "always mediated through the woman, originates in ambiguity" (1981a, p.9).

Grumet's thesis on the development of masculine and feminine epistemologies derives from the Freudian concepts of the oedipal crisis as a prime determiner in the subsequent psycho-social development of the child through the concepts of objects relations theory, where "object relations theory investigates the genesis of personality in the interplay of the aggresive and libidinal drives seeking satisfaction..." (1981a, p.8).

There are some problems inherent in the starting points of Grumet's theories. I do not adhere to the Freudian concepts of ego, id, superego and libido which have become reified over the years, and the concept of drive mechanisms as originally formulated by Lorenz, Tinbergen or others are not considered tenable. This stance assumes the tabula rasa state of the infant and is epitomized by Grumet's (1981a) paraphrase of Chodorow ("...Chodorow's thesis that the infants of both sexes, though polymorphous and bisexual at birth....") (p.11).

This statement of Chodorow's is patently absurd. Children are not polymorphous and bisexual at birth. Masculinization of the fetal brain occurs at about 7 weeks and the corpus callosum is anatomically distinct by 26 weeks. At birth we ascribe sex roles (Hamburg, 1978, p.157) based on examination of the external genitalia. Based on sex roles expected behaviors are reinforced so that the child comes to have a core gender identity that is the "recognition of one's self-concept, of status as male or female" (Hamburg, 1978, p.158), a sex role preference which "refers to the individual's relative desire to adhere to culturally defined sex r[illegible]idelines" (Hamburg, 1978, p.158) and finally, a sex role adoption which "ref[illegible]he overt masculinity or femininity of the individual's publicly observable behavior" (Hamburg, 1978, p.158).

Broverman's (1972) identification of competency clusters based on overt concepts of masculinity and femininity are indicates that they are both consequences and determinants of core gender identity, sex role preference and sex role adoption. Thus, while attributes of masculinity and femininity are in part culturally defined, maleness and femaleness remain biologically determined.

Beach (1978, p.124) gives the following thoughts on the problems of investigating sex and behavior.

> 1. All laymen and nearly all psychologists and psychiatrists implicitly and unconsciously distinguish between male-female and masculine-feminine as separate dyadic categories.
>
> 2. The fundamental issues underlying most treatments of sexuality center upon masculinity and femininity and have relatively little to do with maleness and femaleness as such.
>
> 3. Nearly all problems traditionally dealt with in theories of sexuality are much more relevant to the behavior of men and women than to that of males and females of other species.

The biosocial view would maintain the dyadic separation for investigatory purposes. However, re-integration of the components of the dyad through an inter-specific and cross-cultural search for phylogenetic and ontogenetic universals perforce must occur in order to develop tenable theories of human development.

Grumet (1981a) begins to develop a biosocial view of child development. Although her basis for masculine-feminine dichotomies is in opposition to the basis given herein, there is fundamental agreement that the phenomena occur and that they are vitally important.

Grumet (1981a, p.16) states that,

> Biology and culture influence our contemporary categories of gender and attitudes toward parenting as well as our epistemologies and curricula. This assertion seriously undermines the assumption that curriculum design is a rational activity resting on needs assessments, systems analyses or values clarification.

She goes on to assert that "curriculum becomes our way of contradicting biology and culture" (1981a, p.6). The argument she is advocating leads inexorably to a biosocial perspective for development and the place of public education in that development.

The denial of the biological aspects of the biosocial continuum has led, in Grumet's view, to the ascendancy of masculine epistemologies in curriculum development. Thus,

> rather than merely replicating the society from which they spring, schools contradict many of the dominant social and familial themes in our society. (1981a, p.16).

Therefore,

> because schools are ritual centers cut off from the real living places where we love and labor we burden them with all the ornate aspirations but love and labor are too meager and narrow to bear. (1981a, p.17).

Curricula, then, have become prescriptions for viewing child development as a process/product paradigm. In Grumet's words "masculine epistemology reflects this search for influence and control" (1981a, p.18) and this is, in turn, reflected in our concepts and practices. She accuses both men and women of duplicity in respectively promulgating and acquiescing to this view.

> The degree to which schooling as a social institution imitates the spatial, temporal and ritual order of industry and bureaucracy indicates the complicity of both men and women in support of paternal authority. (1981a, p.20)

Interestingly, support for Grumet's position comes not only from sociobiology but also from researchers in sociology. Boulding (1981), a sociologist, in discussing the interaction of dominance and nurturance structures in societal development makes the following statements,

> The tragedy of human history over the past 12,000 years of settlement and urbanization has been the increasing institutionalization of dominance structures in the public sphere and the pushing of nurturance structures into the private sphere, making it harder and harder for social learning to take place in the very centuries when knowledge about physical and social environments has accumulated the most rapidly. Each time we have reached what historians call an axial age, when accelerated accumulations in scientific and humanistic understanding from various co-existing civilizations seem to come together and promise a breakthrough in human social development, the world has retreated from the threshold of the "new age" under the pressures of deep structures of which it has been unaware. (p.174, her emphases)

Later, in discussing the evolutionary aspects of cultural development she states,

> Schooling as experienced by the average child does little to tap the evolutionary potentials in her being, and many practices in the home and community are more geared to the convenience of adults than the growth of children. In the after-school years we do not even pretend to foster continual growth processes, except in carefully segregated adult educational settings. (p.191)

It is readily seen that Boulding is in agreement with Grumet about the relational aspects of dominance/nurturance roles in present society. There is a perceived need by both authors to re-evaluate the bio-psycho-sociological relationships of individuals developing in society and especially the roles of children. How adults perceive the roles of children and the interaction of adults with children is in dire need of re-examination.

CURRICULUM THEORY FROM A BIOSOCIAL PERSPECTIVE: MIDDLE RANGE

As a "guide to empirical enquiry" biosocial curriculum theory ought to illuminate particular areas for investigation that have potential for furthering theories of the development of individuals within educational systems. This may mean a critical analysis of current systems and suggestions for re-structuring those systems. With respect to particular aspects of human sociobiology, some aspects that commend themselves to our immediate attention follow.

Group Size. The traditional educational approach to group size effects has been to attempt to examine the performance of students in particular academic areas (reading, mathematics, science, etc.) by means of pre-, post-test designs. The developmental time investigated for children has been anywhere from a few months to several years (Glass and Smith, 1978; Ryan and Greenfield, 1975;

Varner, 1978). Considering that a biosocial perspective would point to subtle development in cognitive, affective and psychomotor skills over a much longer period, the average study is of ludicrously short duration.

The consensus of reviews on class-size research is that it is inconclusive. From a biosocial point of view that is to be expected. The members of a classroom are only a group (often sub-grouped unconsciously by the members) for a small part of each day. The group is formed artificially and often sub-divided artificially. Individual members of a class have other primary groups that may be considerably more important to them biologically, psychologically and sociologically. From a biosocial perspective the classroom group is so ill-defined in itself as to make any results questionable.

Also, the size of class groups in most studies fluctuates widely. In some instances the "small" class in one study has more members than the "large" class in another study (Ryan and Greenfield, 1975). It is, it seems, almost impossible to control class size within a system. This is a simple, but important, methodological problem.

Biosocially, there is an expectation of a threshold in group size, beyond which there will be no appreciable change in the affects. This will be similar to the threshold reported by Garbinaro (1980) for school size. Based on the anthropological data (Steward, 1968,) one would expect thresholds to occur when groups approach the 5-7 member range. Travers and Ruopp (1978, in Bronfenbrenner, 1979) reported that group size is a more significant variable for children from 3-5 years of age than those under 3 years of age. Also, as group size increases for 3-5 year olds beyond about 15, no appreciable changes can be determined. Thus, there seems to be at least two threshold values for small groups.

A biological explanation for the threshold at about 4 years of age might be as follows;

i) The child of 3 years or less can only attend to a limited number of contacts and also they are to a large extent egocentric. This is basically the effect of the state of neurological and morphological development.

ii) Between 3 and 5 years of age significant neurological and morphological changes occur that allow the child to expand his/her perceptual range. The child becomes less egocentric.

iii) The child of 3-5 is more likely to accept stimulation from a variety of sources and hence is more likely to be inhibited by some of the stimulation. In effect, the child is capable of being overloaded, whereas younger children simply do not perceive the extra stimulation and hence are not affected.

iv) This explanation is corroborated by electroencephaligraphic recordings that indicate substantial changes in neurological functioning at about 3 years of age. (Lairy, 1975a,b; Epstein, 1978)

Travers and Ruopp (1978) give an environmental/ecological explanation for the phenomenon that is quite plausible. However, the addition of the biosocial data strengthens their argument and creates a biosocial view that indicates an integration of biological predilections mediated and shaped by social factors.

It is important to see here why most studies on class size are inconclusive. The idea that group size will have a significant effect on a particular cognitive

skill measured over a short duration is at best naive. A biosocial perspective behooves investigations of general cognitive/affective/psychmotor skills over a long period (K-12) to determine the develpmental outcomes of process and social skills. We see then a need for a re-assessment of what is being measured and why it is being measured.

Development of Social Relationships. Present western societies espouse equality as a virtue, a social and a legal right. While no quarrel is advanced over the legal aspects of equality, it is patently obvious that each individual perceives themselves as dominant, equal or subordinate to each other individual with whom he/she interacts. Many of these relationships are determined to some extent by social position, but this may be exacerbated or mediated by biological factors, especially among age peers (see Chapter IV above). The data on differential hierarchy development amongst males and females indicates that there are basic biological processes that affect how individuals sort themselves within groups.

It behooves educators to investigate how the educational system affects within-group sorting and how members of one group relate to members of another group. If a teacher, for instance, is a "nerd" in Savin-Williams terminology, how does that affect his relationship to alphas. How does a woman teacher react to an alpha male? How much do age differences offset hierarchy differences. What sex interactions may affect development of the children?

Stanchfield (1973) reports that almost all elementary teachers surveyed preferred to teach girls. Girls were considered to be nicer (cf. Broverman et al.). There are subtle indicators here about how education systems are currently structured and how they might be restructured.

Young children, if left to their own devices, will spontaneously structure the size and composition of their groups. This provides clues as to how to

structure the size and composition of schools and classes to create environments that are conductive to development in cognitive, affective and psychomotor areas.

Sex differences. The argument advanced here is similar to that in Group Size. Previous educational research on sex differences has assumed a very naive view of how sex differences would be manifested. It is not reasonable, from a biosocial perspective, to expect demonstrable differences in narrowly defined cognitive areas such as subject areas.

Sex differences are not single gene affects any more than is mathematics ability. Both are pleiotropic affects mediated by and through cultural factors. Therefore, short-term comparative studies such as have been done are not likely to provide significant conclusions. However, a biosocial view indicates again long-term longitudinal studies (K-12) in which a broad based assessment of cognitive, affective and psychomotor skills will be done. It is to be expected that the manifestation of sex differences in all areas is subtle.

Biosocial theory would predict similar final abilities for males and females in traditional academic subjects (science, mathematics, language, etc.) but different chreods for attaining those abilities. This, in turn, indicates different methodologies for ensuring optimal development for each child. It follows that there are optimal learning/teaching strategies and methodologies for males in particular areas that are not identical to optimal strategies for females in the same areas, and vice versa.

Thus, a biosocial perspective suggests a change in the emphasis from previous research methodologies that have attempted to demonstrate or deny differences to one that assumes certain differences, but uses those differences to optimize development.

Ergonomic Factors. Ergnomics is the study of the problems encountered by people adjusting to their environment and especially their working conditions. As such it has connections to architecture, psychology and other areas such as kinesiology. Researchers in ergonomics are usually concerned with the adaptation of the man-made environment to accommodate the human form and function. Color schemes, furniture design and spatial configurations, etc. are manipulated in order to provide maximum comfort and ease to the worker. The theory is that if the environment and the worker are co-adapted the result will be greater productivity and enhanced well-being (Restak, 1979; Sale, 1980; Toffler, 1980).

Ergonomics has resulted in new designs for such radically different things as chairs, desks, electronic keyboards and toilets. However, the greatest work in this area is done to and for adults. Very little seems to have been done in the area of infant or child ergonomics. Simple scaling down of furniture and other artifacts seems to be the best that is done. This does not often take into account the great disparity in body sizes and body proportions in the age cohorts of pre-schoolers and early elementary school children. Yet there is legislation that requires children to remain for a minimum of ten years in environments that, at best, ignore their biological predispositions at the most fundamental levels.

The need for ecological diversity as postulated by Shepard (1973) is not met by current school designs. In Hart's (1975) view it goes beyond Shepard's postulation of inadequacy to outright inhibition of cognitive/affective development. Sociobiology offers the basis for new ergonomic research into the ecological attributes of functional architecture for children. The data on children's visual development indicates that the standards devised to accommodate adult visual skills may be literally overwhelming for children.

New research is needed on the changing proportions of children's bodies as they grow. Rooms, chairs, desks and other materials need to be scaled to account for these changes. The arguments promoted here indicate that the social skills and process skills (i.e., tolerance and observation) which educators wish to promote will be learned more easily in conducive environments. Sociobiology provides data on environmental adaptation that may be applied to school settings.

Adaptation may be achieved in two ways. Evolutionary adaptation changes the organism to fit the environment. Humans have the ability to shape the environment to fit the organism. Industry has invested great amounts of time and money in ergonomic research for adults. Perhaps it is time to do the same for children.

CURRICULUM DEVELOPMENT FROM A BIOSOCIAL PERSPECTIVE: APPLICATION

It was stated earlier that "the manifestation of sex-influenced differentials of learning in males and females will not be as narrow a subject area, but rather over the whole span of development, learning and socialization as biological potential interacts with sociocultural opportunities". The area of reading is a good example of this view. Reading involves all subject areas and involves learning in a more global sense than does some particular subject area content.

Stanchfield (1973) has summarized a number of years of work on sex-differences in reading and also offers some practical applications for improving the situation. She reports that "at the upper elementary level, boys make up 75% to 80% of all reading disability" (p.5). She also indicates that "enrollment figures from reading clinics show that boys compose 85% of the students in classes for reading improvement." (p.5). This phenomenon is believed to result from "basic differences in the learning patterns of boys and girls" (p.14), and that these

differences are environmental in origin rather than hereditary. However, she then cites a number of behavioral differences between boys and girls that would indicate a biological basis.

The basic differences in learning patterns between boys and girls in the elementary grades may be summarized under the following eight areas:

1. Personality Style

   a) Boys are more aggressive and less conforming. Girls are "nicer". Niceness is an important attribute for girls and connotates non-aggression, interpersonal conformity, restraint and nurturance. Teachers respond differentially to aggressive boys and non-aggressive girls by giving boys more disapproval or blame using harsh or angry tones (Stanchfield, 1973, p.19). (Cf. Broverman et al., competency clusters and Savin-Williams, cruel-mean dichotomy).

   b) Boys have a lower frustration level than girls. Boredom leads to increased irritabiity and then discipline problems. (Stanchfield, 1973, p.20).

   c) Boys are "inner-directed" while girls are "outer-directed". Girls learn to please the teacher, parents, or friends. Boys learn because they want to know about something (Stanchfield, 1973, p.20).

   d) Boys have greater difficulty than girls in adapting to changes in the environment. This interferes with and slows the learning process (Stanchfield, 1973, p.20).

2. Activity Levels

Boys are much more active than girls. They wiggle, twitch, push, scratch, turn and engage in other motor activities more than girls. These activities

distract from the learning process. Teachers perceive boys as more difficult to teach as a result of this greater motor activity (Stanchfield, 1973, p.21)

3. Subject-Matter Interests

As a result of their greater motor activity boys are interested in more dynamic subject matter. In reading, girls' interest is easily held by a large variety of subject matter. Boys tend to be bored by material that does not cater to their specific interests or what is mundane (Stanchfield, 1973, p.23).

4. Listening Skills

Boys seem to have greater difficulty in hearing all sounds and in making fine auditory discrimination. Girls consequently have greater aural-verbal skills. Boys' listening skills improve when they are interested in the material (Stanchfield, 1973, p.24)

5. Verbal Facility

This is directly related to listening skills. Boys are found to be less adequate in oral expression and have greater difficulty with articulation, enunciation and pronunciation. Accordingly, boys participate less in class activities (Stanchfield, 1973, p.25).

6. Auditory Discrimination

This is part of the constellation of aural-verbal skills in which girls exceed boys. Boys have much greater difficulty in auditory discrimination and in hearing common phonetic elements. Therefore, boys require longer times (1/3 to 1/2 more time) to learn and recognize the same words, than do girls (Stanchfield, 1973, p.28).

7. Attention Span

Boys' attention span is 12-15 minutes whereas girls' varies from 20-25 minutes. Boys' spans are increased if they are involved in some physical activity. It seems that attention span for boys is directly related to motor activity and differentials in activity levels (Stanchfield, 1973, p.29).

8. Goals and Motivations

Girls are more eager to please teachers, parents and other adults. Girls react more readily to praise. Boys tend to be less anxious to please adults, less motivated to develop good work habits, less desirous of assuming responsibility and less self-motivated in learning to read (Stanchfield, 1973, p.30).

It is easily seen that Stanchfield has demonstrated a powerful example of biological potential being regulated by environmental factors (genes set the limits of potential development, environment determines possible chreods within those limits). The aggressive, inner-directed nature of boys coupled to the greater lateralization which results in aural-verbal deficiencies relative to girls, means that in given ecosystems boys perforce will perform poorly relative to girls. The remedies suggested by Stanchfield involve changing ecosystem parameters to take into account the biological differences of boys.

It ought to be stated here that we can no longer think in terms of deficiencies, dominance, or superiority, but rather in terms of the optimal development of abilities to adapt to particular ecosystems and perhaps more importantly, to changes in ecosystems.

SUMMARY

In this chapter have been presented three examples of how a biosocial

perspective can powerfully influence curriculum theory and development. This argues favourably for future workers to accept the biological premise as both non-trivial and explanatory when dealing with all aspects of curriculum.

The preceding has shown that accepting the biological premise leads to new questions about bio-psycho-social development. Both old and new methodologies have been utilized in investigating and evaluating the extent of biosocial paradigms in curriculum theory and development.

It becomes incumbent upon future researchers to extend this type of research in child development as both an individual and a social concern. Societal evolution need not necessarily be understood only by hindsight. We have now powerful tools for predicting directions of social change and to some extent to influence those changes in direction.

These changes in direction will, perforce, involve interactive research at all three of Merton's levels: grand theory, middle range theory, and application. The modes of Bochenski and Morrison demand a process of research and theory development at all levels simultaneously. It will be through this multiple approach that significant advances in biosocial curriculum theory will be achieved.

VII. A CODA

> Coda (It.) Tail. Originally a section of a movement added at the end to clinch matters rather than to develop the music further. However, in the symphonies of Mozart, Haydn and especially Beethoven, the coda came to have integral formal significance, becoming at times second development section and sometimes containing new material. Later composers have increased and extended this tendency. (Kennedy, 1980.)

In this final chapter (a coda), will be drawn together the many concepts developed in the dissertation. In the tradition of the coda, the themes developed will be brought together in a short, simplified "tail" to complete the "tale".

Langer (1967) and Rosenberg (1980) have pointed out that psychology and sociology have proceeded in manners contra the natural sciences;

> The main concern of the early physicists was to understand puzzling events; each scientific venture grew from a problem, the solution of which threw unexpected light on other problematic phenomena. It was always in such a light that the concepts of physical science were set up. But the chief preoccupation of the social scientists has been with the nature of their undertaking, its place in the edifice of human knowledge, and - by no means last, though seldomly candidly admitted - their own status as scientists. For decades, therefore, the literature of those new disciplines, especially of psychology, has dealt in large measure with so-called "approaches", not to some baffling and challenging facts, but to all the facts at once, the science itself. Every theoretical thinker in the field set out to define and circumscribe this science and propose a strict, proper method for its pursuit, until a rotating program committee seems to have had the lion's share in the whole venture. (Langer, 1967, p.33)

In this sense then, sociobiology, because it is directly rooted in evolutionary, ecological, and ethological theory, provides a paradigm (protocol statements, hypotheses, and theories) for tackling challenging problems in learning and social behavior both in general, and in particular. There has developed a genuine scientific language that may be used to investigate human behavior. According to Langer (1967, p.36) "genuine scientific language grows up with the increasing abstractness or extraordinary precision of concepts used in a special field of work, and is therefore always just adequate to express those concepts".

Therefore, concepts of learning and social development that have grown out of intra- and inter-specific studies in biological sciences, are based in research on individual challenges and have grown out of the research. The social science method of creating a definition and then attempting to make it "fit" has not been very functional, nor has "prescriptive methodology, which lays down in advance the general lines of procedure - and therewith the lines of thought - to be followed" (Langer, 1967, p.36).

The concepts of prescriptive methodology have led to over-reliance on a naive conceptualization of laboratory type research and a presumptive mathematization in the social sciences (Elsasser, 1975). This in turn has led to the development of learning "theories" based on models taken from classical physics. Unfortunately, these theories have arisen, not out of the research that produces models, but rather out of attempts to make research fit the preconceived models. However, since the models do not reflect the real world situation in learning and development they are not functional in exploring behavior.

> Here I think, we have the central and fatal failing of all the projected sciences of mind and conduct: the actual machinery that their sponsors and pioneers have rented does not work when the "conceptualized phenomena" are fed into it. It cannot process the interpretations that are supposed to be legitimate proxies for its abstract elements. (Langer, 1967, p.41)

The social sciences, from the arguments presented, then, need to change their operational concepts. "The basic need is for powerful and freely negotiable concepts in terms of which to handle the central subject matter, which is human mentality - properly, and not foolishly, called 'mind" (Langer, 1967, p.51). This is in accordance with van den Berghe, Rosenberg and Campbell.

Sociobiology can provide a paradigm for educators to work from basic philosophical and epistemological concerns to elucidate the concepts of learning and social development as biosocial phenomena. In Hamburg's words (1978, p.158), "The term biosocial was selected in order to emphasize the interrelatedness of the biological substrates and the social environment as determinants of human behavior". This can lead to the development of a "technology of education" as the application of theories derived from a "science of education" that is an extension of the sciences of psychology and sociology.

> If a science is to come into existence at all, it will do so as more and more powerful concepts are introduced. Their formulation is often the work of empirical investigators, but it is philosophical, nonetheless, because it is concerned with meanings rather than facts, and the systematic construction of meanings is philosophy. Whenever a new way of thinking may originate, its effect is apt to be revolutionary because it transforms questions and criteria, and therewith the apearance and value of facts. Even basic facts in an older system of thought may seem unimportant in a new one. Ultimately - perhaps at very long

> last - they are rediscovered in terms of the new formulation. But they may be so masked that only the very discerning eye will recognize them.
>
> If a philosophical theory of mind can serve the mental social sciences at all, its effects in those fields of research are likely to be radical. It is not a matter of giving new definitions to old terms, as one might substitute "verbal behavior" for "speech" or "muscular reactions" for "dance" and going on with former lines of thought and experimentation. It means going back to the beginnings of thought about mental phenomena and starting with different ideas, different expectations, without concern for experiments or statistics or formalized language; if the concept of mind is philosophically sound it should serve to define mental processes in ways that make one suspect connections and derivations and should lead from odd facts to bold hypotheses and from hypotheses to verification by any possible means. The experiments should suggest themselves automatically and techniques and language grow up apace. Langer, 1967, p.52)

Langer is arguing here for the development of a "grand theory" (meta-theory) of mind, but the logic of her argument is equally applicable to theories of education if learning and social development are viewed as critical aspects of educational theory. Sociobiology provides a starting point because it has a history of philosophy, grounded in biological philosophy, that has demonstrated the strengths demanded by Langer. Therefore, educators who opt for a biosocial paradigm (in sensu Hamburg, 1978) will be utilizing a proven philosophical and theoretical research base. The continuity of biological and social attributes of all organisms provides a constant against which to measure the human biosocial potential. Educators, in the formal sense, are vitally concerned with human biosocial potentials which ought to entice them to create and examine new questions based on the novel findings of biological development within a physical and societal context.

Biosocial theory development may be pursued at the three levels of grand theory, middle range theory and application simultaneously. In Chapter VI exemplars were presented to demonstrate possibilities of such simultaneous research and also to show how the three levels may be related. The concepts of Bochenski and Morrison provide modes for conceptualization of the type of integration advocated.

It has been noted that the exemplars presented above, although they contribute to a biosocial paradigm of curriculum theory, were not originated from or within such a theory. How much more could we expect from such research if it had been embedded in the type of biosocial paradigm advocated herein?

The development of the major arguments has shown the following:

1. Education has a tradition of co-opting theories of learning and social development and its concepts of the nature of man as guides to empirical enquiry from psychology, sociology and philosphy.
2. Co-option has not resulted in any significant change in learning or development in children in public educational systems because the co-options are done for predictive reasons only (Bereiter, 1973; Stephens, 1967; contra Langer, 1967).
3. Education has a tradition of accepting the biological premise of human development and behavior as trivial and non-explanatory.
4. A biosocial approach provides a powerful paradigm for investigating human development and behavior based on the biological premise as non-trivial and explanatory.
5. Sociobiology is currently influencing social sciences such as psychology, sociology and philosophy, and therefore:

a) education will be indirectly influenced by sociobiology as it co-opts new or changed theories from the social sciences;

b) education can be directly influenced by sociobiology if educators become familiar with its protocol statements, laws and theories;

but this influence will significantly affect educational theories only if:

a) educators accept the biological premise as part of a biosocially interactive system and not as a prescription;

b) sociobiology is co-opted as a paradigm to generate new lines of questioning, new protocol statements, laws and theories about learning and social development stemming from a recognition of the adaptive significance of both the phylogenetic and ontogenetic aspects of development (in this sense, sociobiology is a new guide to empirical enquiry into human development).

No claim has been presented for sociobiology as the only discipline capable of completing the arguments given, but rather to advance sociobiology as a current biosocial discipline that attempts to integrate the wide data base of developmental literature. Hull (1980) makes the point that as natural sciences develop, labels tend to remain the same while concepts change. Thus today's "Darwinians" are quite different from those who were Darwin's contemporaries in terms of their conceptualization of evolutionary theory. But evolutionists today tend to think of themselves as Darwinian through historical continuity.

Ruse (1981), in discussing claims that sociobiology presents a sexist theory that degrades women, concludes the claim to be false. In his summary, the following statements could be used to justify a biosocial perspective for education as well as to refute charges of sexism,

> In other words, by paying deliberate attention, we might be able to overcome our biology. The sociobiology of human sexuality does not, therefore, extol what is (or what is suggested to be) as good, or as inevitable. It is not a doctrine for keeping people in their present state. What it does suggest, rather, is that we are never going to get people out of their present state unless we realize the causes for the state. I suppose it does suggest that change might not be as straight-forward as many environmentalists suggest or without possible deleterious side effects. (p.242)

The key points above are that with evolving organisms the future cannot be controlled without access to the past, and educators are definitely interested in future control. A second point that is equally important is that education is actively involved in social design. The outcomes are not always easy to discern.

Ruse (1981) goes on to describe some of the possibilities of a sociobiological approach to sexuality.

> If human sociobiology works, although we will certainly have replacement of extreme environmental claims, and although we may have some reduction, the sexuality case suggests that, generally, what we might look for is a melding of the biological and the social. Biologists emphasize always that biological characteristics, including behavior, are a product of the genes together with the environment. In other words, while one can understand the fear that social scientists have of sociobiology, the final synthesis will quite possibly be one where biology and social science will be equal and essential partners. (p.243)

The implications of Ruse's statements to education are obvious. Teachers and all other educators will need a thorough grounding in both the biological and social factors that influence the development of the children with whom they interact and for whom they care.

Thus, as sociobiology continues to develop through the fugue-like process of protocol statement developing laws developing theories, it is bound to change its internal characteristics, as has every other area of the natural sciences. Since conceptual breakthroughs in the sciences are impossible to predict, no one can state with any certainty how the sciences will change. It ought to be noted, however, that it has been said that the Nobel Prize in Physics for the year 2000 will be given for work on brain structure and function (Restak, 1979); also physicists are beginning to discuss brain function in quantum physics terms (Capra, 1982; Stuart, Takahashi & Umeqawa, 1979; Wolf, 1981).

Where this type of conceptualization will take us with regard to educational theory is anyone's guess. What is important is that educators as a group must be open to the conceptual change and conceptual unification that will arise from future investigations.

NOTES

NOTE 1

I am indebted to Professor C.I.J.M. Stuart, University of Alberta, for helping me to clarify my thoughts in this chapter and for suggesting the terminology "Methodology of Experimentation" and "Methodology of Conceptual Unification".

NOTE 2

MacLean (1978) has shown that as neurophysiological complexity increases with phylogenetic development, three essentially separate developmental components of the vertebrate brain have come into being. He refers to these components in the full developed vertebrate brain as the triune brain. The three components may be equated with the reptile brain (R-complex) overlain by the paleo-mammalian brain which in turn is overlain by the recent neo-cortex.

> These three formations are distinctly different in chemistry and structure and in an evolutionary sense eons apart. Extensively interconnected, the three basic formations represent an amalgamation of three brains in one, or what may be appropriately called a triune brain. The word triune also implies that the whole is greater than the sum of its parts, because with the exchange of information among the three formations, each derives a greater amount of information that if it were operating alone. Stated in popular terms, the amalgamation amounts to three interconnected biological computers, each having its own special intelligence, its own subjectivity, its own sense of time and space, its own memory and its own motor and other functions. (MacLean, 1978,).

BIBLIOGRAPHY

Albury, R. Human sociobiology, education, and the social construction of scientific knowledge. Australian Science Teachers Journal, 27(2):7-12, 1981.

Barash, D. Sociobiology and behavior. New York: Elsevier. 1977.

Barash, D. The whisperings within. New York: Harper and Row, Pub. 1979.

Barker, R.G. and Gump, P.V. Big school, small school: high school size and student behavior. Stanford, California: Standford University Pres. 1964.

Barlow, G.W. The development of sociobiology: a biologist's perspective. In: Sociobiology: beyond nature/nurture? (G.W. Barlow & J. Silverberg, eds.)

Barlow, G.W. and Silverberg, J. (eds.) Sociobiology: beyond nature/nurture? AAAS Selected Symposium 35. Boulder, Colorado: Westview Press, Inc. 1980.

Bateson, P.P.G. and Klopfer, P.H. (eds.). Human development in ethology, Social Behavior, Vol. 3. New York: Plenum Press. 1978.

Beach, F.A. Human sexuality and evolution. In: Human Evolution: biosocial perspectives (S.L. Washburn & E.R. McCown), 1978.

Benbow, C.P. and Stanley, J.C. Sex differences in mathematical ability: factor artifact. Science, 210:1262-1264. 1980.

Benham, B.J. The implications of sociobiology for education. Educational Studies, 9(3):247-254, Fall 1978.

Bereiter, C. Must we educate? Inglewood Cliffs, N.J.: Prentice - Hall, Inc. 1973.

Bicchieri, M.G. Hunters and gatherers today. New York: Holt, Rinehart & Winston. 1972.

Biggs, J.B. Genetics and education: an alternative to Jensenism. Educational Researcher, 7(4):11-17, 1978.

Birdsell, J.B. Some predictions for the Pleistocene based on equilibrium systems among recent hunter-gatherers. In: Man The Hunter (R.B. Lee & I. DeVore, eds.). 1968.

Blanck, S. Dimorphism in seated postures. University of Chicago: Committee on Human Development. 1971.

Bochenski, J.M. The methods of contemporary thought. (Peter Caws, trans.). Dordrecht, Holland: D. Reidel Pub. Co. 1965.

Bock, R.D. Word and image: sources of the verbal and spatial factors in mental test scores. Psychometrika, 38:437-457, 1973.

Bock, R.D. and Kolakowski, D.P. Further evidence of sex-linked major-gene influence in human spatial visualizing ability. Amer. J. Human Genetics, 25(1):1-14, 1973.

Boorman, S.A. and Levitt, P.R. The genetics of altruism. New York: Academic Press. 1980.

Boulding, E. Evolutionary visions, sociology and the human life span. In: The Evolutionary Vision (E. Jantsch, ed.). 1981.

Bronfenbrenner, U. The ecology of human development. Cambridge: Harvard University Press. 1979.

Bronowski, J. and Ariotti, P.E. (eds.) A sense of the future. Cambridge, Mass.: M.I.T. Press. 1977.

Broverman, I.K., Vogel, S.R., Broverman, D.M., Clarkson, F.E. and Rosenkrantz, P.S. Sex role stereotypes: a current appraisal. J. of Social Issues, 28: 59-72, 1972.

Campbell, D.T. Evolutionary epistemology. In: The Philosophy of Karl Popper (P.A. Schilpp, ed.) 1974.

Campbell, D.T. On the conflicts between biological and social evolution and between psychology and moral tradition. Amer. Psych., 30:1102-1125, 1975.

Campbell, D.T. Social morality norms as evidence of conflict between biological human nature and social system requirements. In: Morality as a Biological Phenomenon (G.S. Stent). 1980.

Capra, F. The Tao of physics. New York: Bantam Books. 1977.

Capra, F. The turning point. New York: Bantam Books. 1982.

Caspari, E. Genetic endowment and environment in the determination of human behavior: a biological viewpoint. Amer. Educ. Res. J., 5(1):43-55, 1968.

Cohen, L.B., DeLoache, J.S. and Strauss, M.S. Infant visual perception. In: Handbook of Infant Development (J.D. Osofsky, ed.). 1979.

De Lacoste-Utamsing, C. and Holloway, R. Sexual dimorphism in the human corpus callosum. Science, 216:1431-1432, 1982.

Dobzhensky, T., Hecht, M.K. and Steere, W. (eds.). Evolutionary Biology. New York: Appleton, Century, Crofts. 1970.

Dubos, R. The wooing of Earth. New York: Charles Scribner's Sons, 1980.

Dubos, R. Celebrations of life. New York: McGraw-Hill, 1981.

Dyer, K.F. Eugenics, sociobiology and the human sciences: lessons from the past for the curricula of the future. Aust. Sci. Teachers J., 27(2)13-22, 1981.

Elsasser, W.M. The chief abstractions of biology. New York: American Elsevier Pub. Co. 1975.

Epstein, H.T. Growth spurts during brain development: implications for educational policy and practice. Education and the Brain, 77th Yearbook of the N.S.S.E., University of Chicago Press. 1978.

Farb, P. Humankind. Boston, Mass.: Houghton-Mifflin Co. 1978.

Fishbein, M.D. Evolution, development and children's learning. Santa Monica, California: Goodyear Press. 1976.

Flacks, M. Towards a biosocial perspective: suggestions from a biologist. Paper presented at Annual Meeting of the American Sociological Association. 1980.

Freedman, D.G. Human infancy: an evolutionary perspective. Hillsdale, New Jersey: Lawrence Erlbaum Assoc., Pub. 1974.

Freedman, D.G. Human sociobiology. New York: The Free Press, 1979.

Garbinaro, J. Some thoughts on school size and its effects on adolescent achievement. J. Youth and Adolesc., 9(1):19-31. 1980.

Glass, G. and Smith, M.L. Meta-analysis of research on the relationship of class-size and achievement. University of Colorado Laboratory of Educational Research. 1978.

Gould, S.J. Ontogeny and phylogeny. Cambridge, Mass.: Belknap Press of Harvard University Press. 1977.

Gregory, M.S., Silvers, A. and Sutch, D. (eds.) Sociobiology and human nature. San Francisco: Jossey-Bass Pub. 1979.

Grumet, M.R. Conception, contradiction and curriculum. Draft of paper presented at Annual Meeting of the American Educational Research Association, Boston. 8-12, 1980.

Grumet, M.R. Pedagogy for patriarchy: the feminization of teaching. Interchange, 12(2-3):165-184, 1981(a).

Grumet, M.R. Other people's children. Draft paper presented to the Annual Meeting of the American Educational Research Association. Los Angeles. 1981(b).

Guthrie, R.D. Evolution of human threat display organs. In: Evolutionary Biology (T. Dobzhensky, M.K. Hecht and W. Steere, eds.). 1970.

Guthrie, R.D. Body hot spots: the anatomy of human social organs and behaviors. New York: Van Nostrand Reinhold. 1976.

Hadamard, J. The psychology of invention in the mathematical field. Princeton: Princeton University Press. 1945.

Hamburg, B.A. The biosocial bases of sex differences. In: Human Evolution: Biosocial Perspectives (S.L. Washburn and E.R. McCown, eds.). 1978.

Hart, L.A. How the brain works. New York: Basic Books, Inc. 1975.

Hinde, R.A. Animal behavior: a synthesis of ethology and comparative psychology (2nd ed.). New York: McGraw Hill Book Co. 1970.

Hinde, R.A. and Stevenson-Hinde, J. Constraints on learning: limitations and predispositions. New York: Academic Press. 1973.

Holton, G. Thematic Origins of Scientific Thought. Cambridge: Harvard Univ. Press. 1973.

Hull, D.L. Philosophy of Biological Science. New Jersey: Prentice - Hall, Inc. 1974.

Hull, D.L. Sociobiology: another new synthesis. In: Sociobiology: Beyond Nature/Nurture? (G.W. Barlow and J. Silverberg, eds.). 1980.

Jantsch E. The evolutionary vision. Boulder, Colo.: Westview Press, Inc. 1981.

Kagan, J. Continuity and stage in human development. In: Perspectives in Ethology, Vol. 3, Social Behavior (P.P.G. Bateson and P.H. Klopfer, eds.), 1978.

Kennedy, M. The concise Oxford dictionary of music. New York: Oxford University Press. 1980.

Kimura, D. Functional asymmetry of the brain in dichotic listening. Contex, 3:163-178, 1967.

Kimura, D. Spatial localization in left and right visual fields. Canad. J. Psych., 23:445-458, 1969.

Kolata, G.B. Math and sex: are girls born with less ability. Science, 210:1234-1235, 1980.

Kowler, E. and Martins, A.J. Eye movements of preschool children. Science, 215:997-999, 1982.

Kuhn, T.S. The structure of scientific revolutions. International Encyclopedia of Science, Vol. 2, No. 2. Chicago: University of Chicago Press. 1970.

Lairy, G.C. The EEG and psychology of the child. Handbook of Electroencephalography and Clinical Neurophysiology, Vol. 6, Section IV. Amsterdam: Elsevier Scientific Pub. 1975.

Lairy, G.C. (ed.). The evolution of the EEG in normal children and adolescents from 1 to 21 years. Handbook of Elecroencephalography and Clinical Neurophysiology, Vol. 6, Section III. Amsterdam: Elsevier Scientific Pub. 1975.

Lang, W.A. and West, L.W. Human nature, sociobiology and counselling. Can. Counsellor, 14(3):167-173, 1980.

Langer, S.K. Mind: an essay on human feeling. Vol. I. Baltimore: Johns Hopkins University Press. 1967.

Lee, R.B. and DeVore, I. (eds.) Man the hunter. Chicago: Aldine Pub. Co. 1968.

Lenneberg, E. Biological foundations of language. New York: John Wiley & Sons, Inc. 1967.

McLean, P.D. A mind of three minds: educating the triune brain. Education and the Brain, 77th Yearbook of the NSSE. Chicago: University of Chicago Press. 1978.

McGlone, J. Sex differences in human brain asymmetry: a critical survey. Behaviorial and Brain Sciences, 3:215-263, 1980.

Magoon, A.J. Sociobiology and schooling. Educational Researcher. 7(4):4-10, 1978.

Mandel, B. Biology, culture and society: an explanation of human development. Paper prepared for the members of the Sociobiology Panel at the Annual Meeting of the American Sociological Association. Boston, Mass. 27-31, 1979.

Maslow, A.H. A theory of human motivation. Psychological Review, 50:370-396, 1943.

Mayr, E. Animal species and evolution. Cambridge, Mass.: Belknap Press of Harvard University Press. 1963.

Mayr, E. The nature of the Darwinian Revolution. In: Human Evolution: Biosocial Perspectives (S.L. Washburn & E.R. McCown, eds.). 1978.

Merton, R.D. Social theory and social structure. New York: The Free Press. 1968.

Miller, J.G. Living systems. New York: McGraw - Hill. 1978.

Minifie, F.D. and Lloyd, L.L. (eds.). Communication and Cognitive Abilities: Early Behavioral Assessment. Baltimore: University Park Press. 1977.

Morowitz, H.J. The wine of life. New York: Bantom Books Inc. 1981.

Morrison, F.J. Personal Communication. Model presented in Seminar, Family Studies. Edmonton: University of Alberta. 1982.

Oates, M.J. and Williamson, S. Women's colleges and women achievers. Signs, 3(4):795-806, 1978.

Osofsky, J.D. and Connors, K. Mother-infant interaction: an integrative view of a complex system. New York: Wiley & Sons. 1979.

Piaget, J. Biology and knowledge: an essay on the relations between organic regulations and cognitive processes. Chicago: University of Chicago Press. 1971.

Piaget, J. Behavior and evolution (D. Nicholson-Smith, trans.). New York: Random House. 1976.

Piaget, J. Adaptation and intelligence: organic selection and phenocopy. (S. Eames, trans.) Chicago: University of Chicago Press. 1980.

Popper, K.R. and Eccles, J.C. The self and its brain. Berlin: Springer International. 1977.

Porwoll, P.J. Class size: a summary of research. Arlington, VA: Educational Research Services, Inc. 1978.

Pugh, G.E. Behavioral science and the teaching of human values. Int. Rev. Educ., 26(2):103-120, 1980.

Restak, R.M. The brain: the last fronteir. New York: Warner Books Inc. 1979.

Rosenberg, A. Sociobiology and the preemption of social science. Johns Hopkins University Press. 1980.

Rosenfeld, A. Sociobiology stirs a controversy over limits of science. Educational Horizons, 59(2):7074, 1981.

Ruse, M. The philosophy of biology. London: Hutchinson & Co. Ltd. 1973.

Ruse, M. Sociobiology: sense or nonsense. Dordrecht, Holland: D. Reidel Pub. Co. 1979.

Ruse, M. Is science sexist? Boston: D. Reidel Pub. Co. 1981.

Ryan, D.W. and Greenfield, T.B. The class size question. Toronto: Ontario Institute of Education. 1975.

Salapatek, P. and Banks, M.S. Infant sensory assessment: vision. In: Communication and Cognitive Abilities: Early Behavioral Assessment (F.D. Minifie and L.L. Lloyd, eds.). Baltimore: University Park Press. 1977.

Sale, K. Human scale. New York: Coward, McCann and Georghegan. 1980.

Savin-Williams, R.C. Dominance-submission behaviors and hierarchies in young adolescents at a summar camp. Ph.D. dissertation, University of Chicago. 1977.

Schilpp, P.A. (ed.) The philosophy of Karl Popper. LaSalle, Illinois: Open Court Pub. Co. 1974.

Shepard, P. The tender carnivore and the sacred game. New York: Charles Scribner's Sons. 1973.

Simpson, G.G. This view of life. New York: Harcourt, Brace & World. 1963.

Stanchfield, J.M. Sex differences in learning to read. Phi Delta Kappa Fastback, 19, 1973.

Stent, G.S. Morality as a biological phenomenon. Berkeley: University of California Press. 1980.

Stephens, J.M. The process of schooling. New York: Holt, Rinehard & Winston, Inc. 1967.

Steward, U.H. Causal factors and process in the evolution of pre-farming societies. In: Man the hunter (Lee, R.B. and DeVore, I. eds.). 1968.

Stuart, C.I.J.M., Takahashi, V. and Umezawa, H. Mixed-system brain dynamics: neural memory as a macroscopic ordered state. Foundations of Physics 9(3/4):301-327, 1979.

Tanner, D. and Tanner, L.N. Curriculum development (2nd edition). New York: MacMillan Pub. Co., Inc. 1980.

Tinbergen, N. The study of instinct. London: Oxford University Press. 1951.

Toffler, A. The third wave. New York: Bantam Books Inc. 1980.

Travers, J. and Ruopp, R. National day care study: preliminary findings and their implications. Cambridge, Mass.: Abt. Associates. 1978.

Trivers, R. Sociobiology and politics. In: Sociobiology and Human Politics (E. White, ed.) 1981.

Uttal, W.R. The psychobiology of mind. Hillsdale, N.J.: Lawrence Erlbaum Associates Inc. 1978.

van den Berghe, P.L. Bridging the paradigms: biology and the social sciences. In: Gregory, Silvers and Sutch. 1980.

Varner, S.E. Class size. Washington, D.C.: National Education Association. 1978.

Waddington, C.H. The evolution of an evolutionist. Edinburgh: Edinburgh University Press. 1975.

Washburn, S.L. and McCown, E.R. Human evolution: biosocial perspectives. Menlo Park, CA: Benjamin/Cummings Pub. Co. 1978.

White, E. (ed.) Sociobiology and human politics. New York: D.C. Heath and Co. 1981.

Williams, R.J. Biochemical individuality. New York: John Wiley & Sons. 1956.

Wilson, E.O. Sociobiology: the new synthesis. Cambridge, Mass.: Belknap Press. 1975.

Wolf, F.A. Taking the quantum leap. Cambridge, Mass.: Harper & Row Pub. 1981.

Young, J.Z. Programs of the brain. London: Oxford University Press. 1978.

Zais, R.S. Curriculum: principles and foundations. New York: Thomas Y. Crowell Co. Inc. 1976.

Zukav, G. The dancing Wu Li masters. New York: William Morrow & Co., Inc. 1979.