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JEROME S. BRUNER'S THEORY OF KNOWLEDGE: A PHILOSOPHICAL CRITIQUE

BY

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A THESIS

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ABSTRACT

The underlying tenet of the thesis is that empirical studies, particularly in the area of cognitive developmental psychology, are relevant to philosophical discussions, especially those of epistemologists. The thesis itself is a critical examination of a theory of knowledge which emerges from the empirical and theoretical writings of psychologist and educational theorist, Jerome S. Bruner.

Chapter I sets up a general framework in which the two fundamental concepts of development and cognitive are explored. Chapter II is concerned with establishing Bruner as a cognitive developmental theorist and explicating those educational proposals of his which derive from his theorizing in this area and from his explicit remarks concerning the nature of human knowledge. Here Bruner's general epistemological views are set forth in terms of an analysis of the proposition, "X knows p". The upshot of my remarks in this area is that I classify Bruner as an epistemological pragmatist and argue that Bruner views human knowledge essentially as a tool-like, sophisticated set of abilities. Further, I point out that knowledge can take one of two possible forms: a public form in which the corporate knowledge in a given culture is codified in a visible, publicly accessible form, and a private form in which each human cognizer possesses his own set of capacities, most or all of which are derived from the public form.

Chapters III and IV are philosophical critiques of these two forms. In Chapter III, I argue that the notion "structure of a discipline" as referring to the public form of knowledge is radically equivocal in Bruner's writings and that it is impossible to derive a consistent program of action either for curriculum developers or teachers in the classroom from Bruner's discussion of this notion. In Chapter IV, I argue that the central notion "model of the world", the private form of knowledge, is essentially an incoherent notion in Bruner's writings and that if this incoherence is admitted, Bruner's theory of validation becomes highly suspect. Again, educational recommendations flowing from this latter notion also lose much of their force since it is no longer clear what one is seeking, from a pedagogical point of view, when one tries to develop a model of the world in one's students.

In short, the thesis is an attempt to examine a highly influential theory of human knowledge, a theory which has been translated into very practical terms in the schools of North America, and it is an attempt to show that some of the philosophical underpinnings of this theory are, at best, highly suspect and hence, that the curriculum inspirations should be received with a great deal more reserve than has presently been the case.

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CHAPTER I

In his book, Conditions of Knowledge, Israel Scheffler outlines five important questions concerning the problem of knowledge:[1]

(1) What is knowledge? That is, how can we describe or define it?

(2) What knowledge is most reliable or important?

(3) How does knowledge arise? That is, how do men and animals compare with respect to knowing and the acquisition of knowledge? What processes and mechanisms do we ascribe to man to account for intellectual growth over his life span?

(4) How should the search for knowledge be conducted? That is, to what extent is our knowledge of cognitive development restricted by our logic or constrained by our experimental procedures?

(5) How is knowledge best taught?

In setting out these five questions, Scheffler points to a multitude of thorny issues which have occupied philosophers, psychologists, and educators over many years. As is obvious, all of these questions stem from a fundamental epistemological concern, the nature of human knowledge. Traditionally, however, the task of answering these questions has been divided among different sets of individuals. That is, whereas philosophical epistemologists have dealt primarily with questions (1), (2) and, possibly, (4), psychologists have dealt primarily with (3), and educators with question (5).

No longer is this division of tasks always the case. In fact, some individuals working in the area of cognitive developmental psychology are attempting to answer all five

questions. Such individuals receive the title "genetic epistemologist" or that of "psychophilosopher." As Bärbel Inhelder says, in discussing the work of Piaget,

> Piaget has, from the very beginning of his career, constantly posed questions of genetic epistemology. It is true that, in their most general terms such questions as: 'What is knowledge?' can give rise only to speculative controversy; but, if formulated in more restricted terms and in terms of genesis, questions such as 'Under what laws does knowledge develop and change?' can be dealt with scientifically. Research work in genetic epistemology seeks to analyze the mechanisms of the growth of knowledge insofar as it pertains to scientific thought and to discover the passage from states of least knowledge to those of the most advanced knowledge.[2]

Although Piaget himself eschews major attempts to answer question (5), this is not the case with Jerome Bruner. As shall be seen in this thesis, Bruner attempts to deal with all these questions.

In a seminal essay, psychologist William Kessen sets forth what he considers to be important questions for any theory of cognitive development.[3] Underlying his entire essay is the fundamental assumption that <u>any</u> psychological analysis is based on certain epistemological first principles. As Kessen states,

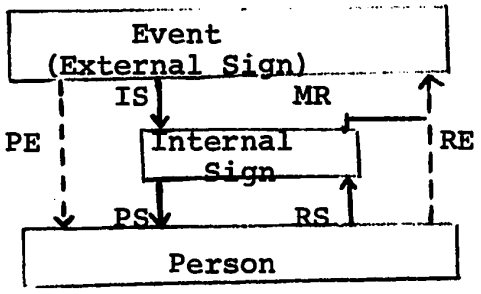
> Before we can establish a psychology of cognition, we must state the basis of our belief in stable characteristics of reality. By and large, this requirement will lead us to the recognition that reality is constructed, not immanent in man or in stimulus, and that contained in every particular psychological theory is a particular epistemological system....I most strongly maintain that our epistemological preconceptions, whatever they be, infiltrate our view of the developing child.[4]

For example, if the psychologist assumes that the contemporary definition of material reality in terms of molecular structure is 'the' definition of reality, it will be extremely difficult for him to describe, in terms of his theory, the comprehension of physical reality that is most likely to be that of the young child, viz. an incoherent set of impressions, many of which are value-laden and in which the child has not yet perceived himself as an independently existing object with a permanent identity. Or, more specifically, if the developmental psychologist utilizes such sophisticated notions as event, property of an event, intensity and duration, position, etc., then, Kessen argues, he will miss the most fascinating questions in developmental psychology concerning how the child comes to arrive at these adult concepts. Kessen does not, however, advocate a return to the perceptions of the child. In fact, most psychologists would agree that we cannot recapture that form of experience in which self and external world are not yet differentiated. Nevertheless, Kessen maintains that, "...it is only an evasion of the problem of our prejudices to maintain that there is anything like uncluttered and premise-free observation. Taxonomy has its own epistemological basis."[5]

Another example of the way epistemological issues intrude into psychology is the following. According to W.M. O'Neil,[6] psychologists can be divided between those who maintain that what we perceive is the real, externally existing object and

those who maintain that we perceive some sort of internal representation. While some psychologists, namely, the early behaviorists, sided with the naïve realists, most psychologists have accepted some version of a causal analysis of perception and have differed primarily on their views of the nature of the internal representations involved in the causal chain. As shall be seen, Bruner clearly falls into the second category.

Those psychologists who have ascribed to some version of a causal theory of perception and a representational theory of knowledge assign a crucial role to the mediating representation. The basic idea of this type of theory can be represented in the following diagram:[7]



PE - perception of event
RE - reaction to event
IS - internalization of the sign
RS - reaction to internal sign
MR - mediating representation
PS - perception of the internal sign.

According to this diagram, the perceiver in some way acknowledges a change in his environment and, through the presence of some internal representation, reacts to the new representation by reference to other internalized representations,

and then responds on that basis. In this theory, then, the internal representation is not only the key to attaining knowledge but is coextensive with knowledge. Moreover, intelligent behavior is not to be explained by reference to some item or state of affairs in the external environment but, rather, by reference to particular representations of external reality which are internal to a given individual. The nature of these mediating representations may be thought of very crudely as simple associations, as was thought by the early empiricists such as Locke and Hume, or may be thought of as highly sophisticated structures, organized in hierarchical fashion, or, using Tolman's terminology, as cognitive 'maps'. As will be seen from my discussion in this and remaining chapters, Bruner's developmental theory clearly commits him to this kind of approach to human knowing.

To facilitate my initial discussion of Bruner's views I shall use this chapter to set up a very general framework. First, in section A, I shall consider what is meant by saying of someone that he is a <u>developmental</u> psychologist. Secondly, in section B, I shall discuss briefly the range of phenomena which is delimited under the description of <u>cognitive</u> developmental psychology. Chapter II, then, will be concerned specifically with an exposition of Bruner's views as they fall into this general framework.

<u>Section A: The Meaning of "Development"</u>:

Most developmental psychologists agree that organisms

which are capable of development, particularly animals and humans, are essentially open, that is, they are systems in which irreversible changes take place as a result of the interaction of the organism and its environment, as opposed to machines in which a fixed set of relations determines the input and output and in which no changes other than deterioration are observed. Given this view of the organism as open, John Anderson procedes to describe developmental theory in the following way:

> Developmental theory...studies the way in which the products or results of learning are incorporated into evolving systems of behavior, and how they function as constituents in subsequent development.[8]

General terminology is, however, not entirely consistent in this area of psychology and often psychologists use the terms "growth" and "development" interchangeably. Nevertheless, for purposes of this thesis, I shall distinguish between these two terms and utilize the distinctions set forth by T. C. Schneirla who maintains that the term "growth" should be limited to mean "change by tissue accretion" whereas the term "development" refers to "progressive changes in the organization of an individual considered as a functional, adaptive system throughout its life history."[9] Seen in this way, growth is one form of development but of a specific sort. This distinction will be maintained because although Bruner talks interchangeably in terms of growth and development, he is not only classified as a developmental psychologist but his theory satisfied the requirements of a theory of development, as

shall be seen in Chapter II.

To the definition of "development" offered above, I propose to join the following remark made by Heinz Werner, a remark which though essentially Piagetian in origin, expresses well the basic principle in Bruner's theory:

> Developmental psychology postulates one regulative principle of development; it is an orthogenetic principle which states that wherever development occurs it proceeds from a state of relative globability and lack of differentiation, articulation, and hierarchic integration. This principle has the status of an heuristic definition.[10]

Translated in Brunerian terminology, this remark parallels Bruner's frequent comments about development consisting in an organism's ability to operate with increasingly more powerful modes of representation, each of which is more sophisticated and comprehensive than the mode preceding it. However, contra Werner, it is not at all obvious that Bruner would agree to Werner's characterization of this notion as merely a "heuristic definition". For Bruner, it would appear that the above statement represents a theoretical description of the actual behavior of human beings as they develop cognitively.

Turning to the psychologists' own characterization of the nature of developmental theory, we find one of the clearest expositions in a recent article by L. Kohlberg and R. Kramer where the authors claim to be setting forth the three main criteria of developmental theory, as this theory is understood in the Piaget-Werner-Bruner tradition.[11] The three criteria are:[12]

(1) Development involves change in the general shape,

> pattern, or organization of response, rather than change in the frequency or intensity of emission of an already patterned response;
>
> (2) Developmental change involves newness, a qualitative difference in response...the emergence of a novel structure of response; and,
>
> (3) Developmental change entails irreversibility; once a developmental change occurs, it cannot be reversed by the conditions and experiences that gave rise to it.

Although one may experience great difficulty in deciding, in actual cases, whether or not some change is developmental or not[13], the key notion in the above criteria is the concept of irreversible qualitative structural change. This concept is often given more specific expression in relation to the notion of 'stage of development' and I shall return to this latter notion shortly.

Not only psychologists adhere to the above three criteria. It appears that some philosophers do so as well. In an essay entitled "Determinism and Development",[14] Ernest Nagel discusses the notion of development and points out that the term "development" is clearly <u>not</u> applied to systems which are undergoing cyclic or repetitive alterations. Rather, the term seems to be reserved for instances of cumulative irreversible change. Moreover, Nagel stresses the importance of what Kohlberg and Kramer have labelled "qualitative" change, stating:

> Moreover, in a somewhat narrower sense, the term is reserved for changes which are not merely irreversible, or which yield only a greater numerical complexity; those changes must in addition eventuate

> in modes of organization not previously manifested in the history of the developing system, such that the system acquires an increased capacity for self-regulation, a larger measure of relative independence from environmental fluctuations.[15]

Hence, Nagel singles out two important characteristics of developmental change: 1) change takes place within an organism which has a definite structure and set of pre-existing capacities; and, 2) the sequence of changes which are termed "developmental" lead to changes both in this structure and the kinds of operations of which the organism is capable. Further, when descriptions of these changes are found universally within a species of organism, they are often referred to as developmental laws which state the relations involved in the sequential order of changes resulting in various states.[16] Precisely how Bruner's theory of cognitive development exemplifies the above remarks concerning developmental theory will be made clear in Chapter II.

More often than not, the notion of developmental theory presented above relies heavily on the notion of <u>stage</u> as one of the chief explanatory concepts. However, there is a great deal of ambiguity surrounding this notion. Kessen distinguishes at least four uses or senses:[17]

(1) The literary-evocative use, in which the word "stage" is used as a metaphor. For example, children may be said to be "in the chimpanzee stage";

(2) "Stage" used as a paraphrase for Age and for Observation. In this case, talk about stages is redundant and no loss of theoretical importance takes place when the notion is omitted;

(3) "Stage" as a description of the environment. For example, we speak of the child as being "at the school stage". Again, this use can be replaced without theoretical loss;

(4) "Stage" as specifying parameters of variation.

For Kessen, this last use of the term is essentially a theory-laden one. Insofar as actual parameters of variation can be specified only with respect to some general and inclusive theory of human development which applies throughout the entire course of development, it is clear that theory is logically implicated by this use of the notion of stage. As Kessen remarks:

> To say that a child is in a pre-operational stage is to say much more than that he is such and such an age or that he can solve such and such a problem. There is included the statement, based on theory, that his approach to, and competence with, all problems demanding abstract operations will be of a particular and specific kind.[18]

In explaining Piaget's use of the notion of stage, Inhelder sets forth four criteria of a stage:[19]

(1) Each stage involves a period of formation and a period of attainment which is characterized by the progressive organization of a composite structure of mental operations;

(2) Each structure constitutes at the same time the attainment of one stage and the starting point of the next stage;

(3) The order of succession of the stages is constant although ages of attainment can vary within certain limits as a function of factors of motivation, exercise, cultural milieu, etc.; and,

(4) The transition from an earlier to a later stage follows a law of implication analogous to the process of integration, preceding structures

becoming a part of later structures.

Of these criteria, criteria (3) and (4) appear to be the most relevant ones in the literature. Kohlberg and Kramer[20] stress these criteria in a somewhat more sophisticated way by saying that the concept of developmental stage implies (1) that the change occurs in a pattern of universal, stepwise invariant sequences; (2) that the stages form a hierarchy of functioning within the individual; and, (3) that each stage is a differentiation and integration of a set of functional contents present at the prior stage. Thus, it would appear that the notion of developmental stage places great stress on increasingly more powerful modes of functioning within the individual. These basic concepts concerning development and developmental stages will be further clarified when I consider an instance of them in the work of Bruner, in Chapter II.

Section B: The meaning of cognitive developmental psychology:

If one looks into standard works in the area of cognitive psychology, one finds that the term "cognition" has not significantly altered its meaning since it achieved prominence with the philosophers of the Modern Period. In fact, the term seems to retain the same meaning as that given by Descartes. For Descartes, "cognition" referred not only to thinking, in the narrow sense of the word, but also to willing, understanding, imagining, feeling, and perceiving.[21] Contemporary psychologists appear to accept this meaning of the term with respect to its extension.

Along more technical lines, the term "cognition" may be said to refer to:

> ...all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations. Such terms as 'sensation', 'perception', 'imagery', 'retention', 'recall', 'problem-solving' and 'thinking', among many others, refer to hypothetical states or aspects of cognition.[22]

Although this description would seem to encompass almost all human activity, it is differentiated from other branches of psychology in terms of its starting point, viz. sensory input. Moreover, cognitive psychology is avowedly mentalistic in tone. In opposition to such psychologists as the behaviorists, the cognitive psychologist Neisser rejects the claim that appeal to these processes is, at best, hypothetical. As he puts it, "The basic reason for studying cognitive processes has become as clear as the reason for studying anything else: because they are there.... Cognitive processes surely exist, so it can hardly be unscientific to study them."[23]

Not only do such cognitive processes actually exist, says Neisser, but they are highly constructive in nature, a view which is affirmed over and over by both Piaget and Bruner. For example, consider the case of visual perception. We see, says the cognitive psychologist, by receiving a series of pictorial copies which are related in terms of a certain pattern. This pattern, which is suggested already with the first bit of input information, becomes increasingly fleshed out with

continuing sensory experience. As Neisser puts it, we "make" (sic) stable objects by use of a "...constantly developing schematic model, to which each new fixation adds new information."[24] In short, we construct the object with which we deal and this constructed object may bear varying degrees of relation to the actually existing object in the external world. Where does all this construction take place? Obviously in the head, and that is where the constructed object which is the result of various conceptual transformations of the original data is located. In terms of the diagram presented above on page 4, visual perception presents its own set of mediating representations. It is similarly the case with auditory perception. In arriving at the understanding of a set of sounds presented to us, we transform this data with reference to those linguistic structures at our disposal such that the sound presented becomes some sort of meaningful utterance or, failing to become meaningful, is nonsense. Again, for the cognitive psychologist, hearing is essentially a constructive activity. Unfortunately, for the investigating psychologist, we do not appear to be aware of these constructive processes although we are assured that they are going on all the time. Rather, the assertion of their existence is the result of an inferential process which argues that intelligent human behavior is the result of the interworking of these constructions. Moreover, perceptual processes seem simple when compared with other forms of cognitive processes.

As Glucksberg points out,

> In its simplest form, thinking is a representation of an external event. In its more complex forms, thinking may be a series of representations which follow formal transformational rules, or it may involve representations of still other representations.[25]

Thus, it seems clear that a cognitive psychologist is concerned with the same sort of issues which have concerned epistemologists for several hundred years, viz. issues dealing with the relation between reality and man's representation of that reality in various forms of knowledge. Given this concern, then, it is not unexpected that psychologists concerned with cognitive development are interested in the way the child comes to know the world and how that knowledge gets transformed into what might be called 'adult knowledge' of the world. In its most general terms, this interest is described by Kessen in the following way:

> The defining problem of cognitive development is to comprehend how an organism of a particular kind, in encounters with phenomena defined in a particular way, constructs the world.[26]

Here, again, Kessen cautions the reader to be aware that even the defining of the problem in this way carries with it epistemological implications concerning the nature of man and the nature of reality.

Cognitive psychologists appear to agree that cognitive development can be generally characterized in terms of greater and greater degrees of independence of behavior from information being received from the immediate environment. The

explanation frequently offered for this greater independence is that the developing individual is increasing his ability to operate abstractly, or what is taken to be an equivalent expression, to manifest an "...increasing intervention of symbolic processes."[27] That is, growth in independence is seen as the result of the use of more and more sophisticated and powerful structures which intervene before the individual responds to the data initially received.

It now becomes highly relevant to ask this question: what <u>are</u> these cognitive structures? This is not an easy question to answer. Rowland and McGuire define cognitive structures as:

> ...multidimensional and interdependent hierarchies, by means of which the human organism emits observable behaviors which are evidence of the development of 'intelligence'.[28]

Moreover, the sequence in which these structures arise appears to be necessary and invariant. In addition, although cognitive structures are highly correlated with the neurophysiology of the brain, they are not regarded as identical with such physiological processes.

In a less comprehensive fashion, Neisser refers to cognitive structures as "nonspecific but organized representations of prior experience".[29] Such representations are deserving of the label 'structure', says Neisser, because the parts have regular and controlling interrelations. And not only do the structures have interrelations which are control-

ling but, as indicated in the first definition presented, they are the means by which we are able to act intelligently. That is, the function of cognitive structures in our experience appears to be that of a kind of compressor of incoming data which is then classified and coded in terms of other structures which are present.

In referring to specific examples of cognitive structures, Neisser distinguishes at least three levels. First, we possess structures concerning classes of objects,or categories, such as the structures "trees", "ironing boards", "elephants" etc. Secondly, we appear to possess a spatial and temporal framework structure within which objects are encountered. For example, one kind of spatial structure would be our grasp of surrounding geography; another kind would be our grasp of the position of the earth within the solar system within the galaxy of the Milky Way. Examples of temporal structures might be our understanding of general patterns of development in Western civilization, our grasp of the time of the year in relation to the other seasons. Finally, on a third level, we appear to possess a higher-order unifying conceptual system or structure which allows us to integrate lower-level structures. One aspect of this conceptual system would be a grasp of the notion of an external physical world existing independently of oneself and, correlatively, a knowledge of oneself and one's own personal history. When either or both of these aspects of the higher-order cognitive structure is

lacking in the adult, he seems unable to emit any significant amount of intelligent behavior. Obviously, then, cognitive structures are introduced as the chief explanatory factor with respect not only to adult intelligent behavior but also as the main explanatory device in dealing with various kinds of behavior characteristic of children at various stages in their cognitive development.

As was seen schematically in the diagram presented above on page 4, cognitive structures play essentially an intermediary role in the total experience of the human organism. As Neisser puts it,

> Whether beautiful or ugly or just conveniently at hand, the world of experience is produced by the man who experiences it... There certainly is a real world of trees and people and cars and even books, and it has a great deal to do with our experiences of these objects. However, we have no direct immediate access to the world, nor to any of its properties. The ancient history of eidola, which supposed that faint copies of objects can enter the mind directly, must be rejected. Whatever we know about reality has been mediated, not only by the organs of sense, but by complex systems which interpret and reinterpret sensory information.[31]

Once, however, one introduces the notion of cognitive structures or coding systems as they are called by Bruner, the cognitive psychologist must also admit that the probability of bias and distortion with respect to later experience has risen considerably. Bruner and others appear very willing to admit this. In fact, much of Bruner's early and highly significant work dealt precisely with this phenomenon in the area of perceptual distortion. And, indeed, it would appear that the problem of

distinguishing between, for example, veridical and non-veridical perceptions becomes increasingly acute insofar as it is not at all evident how the cognitive psychologist can account for error if we can never get outside our sets of cognitive structures. It would seem that perceptual truth would become largely a matter of consistency and coherence rather than correspondence of any sort. Although I shall return to this problem,particularly in Chapter IV, it is relevant to mention here one attempt to deal with this problem. This attempt is that of Daniel Berlyne.[32] Although Berlyne himself has tried strenuously to translate the language of cognitive psychology into the terminology of behaviorism, he, too, admits that there are such things as cognitive processes which are internal to the individual and which represent, in some cases, external objects. Moreover, Berlyne argues that such processes not only contain information about the external world, they also possess what he calls "informational correspondence".[33] This is a somewhat technical term which is to be understood in a weaker sense than isomorphism (which seems only reasonable since we obviously do not have, for example, physical tables in our heads!) and which is defined as implying "...a one-to-one correspondence between elements of a representation and elements of the external world about which they convey information."[34] Whether or not this notion, if coherent, accounts for the difficulty mentioned above will not be discussed in the context of this thesis. Nevertheless, a very similar solution has been proposed by

Bruner and I shall deal critically with Bruner's account in Chapters III and IV of this thesis.

CHAPTER II

In this chapter, I shall present a summary of Bruner's work, particularly his later work which is more distinctly developmental in nature. The chapter will be divided into four parts. In the first part, a short exposition of Bruner's work on perception is given, the stress being placed on the continuity of this work with his later research. The second part deals specifically with Bruner's developmental theory. The third is a specific illustration of this theory: Bruner's account of the emergence of the notion of "the world", an extremely important notion for the epistemologist; and the fourth deals with those educational recommendations which grow out of Bruner's psychological views and which will form the basis of my critical investigation in Chapters III and IV.

In general, for Bruner, it is accurate to say that he maintains that representation is absolutely central to a human being's ability to function. Without some form of mediating representation, argues Bruner, human beings would live within an environment of incoherent and disorganized impressions and would be unable to act purposefully in any way. Each of us, maintains Bruner, possesses an internal model which is related to the world around us and it is through this model that we interpret experience. The extent to which this model accurately portrays how things are is

the extent to which it is adaptive. If very little corresponds to the external world, then it is regarded as maladaptive and, in the extreme case, the human organism is classified and described as highly psychotic. One important implication of postulating this model is that one is compelled to give up the notion of "model-free" experience. In the essay entitled, "The Psychology of Pedagogy", Bruner states,

> ...'experience' is relative to the code in terms of which it was interpreted; it is never had neat and neutral. This is commonplace, of course, in the philosophy of science since Mach (1914), but it is an issue often neglected in discussions of education save in attacks on relativism.[1]

Moreover, Bruner argues that this view grows directly out of his early work on perception and the strategies which people employ in dealing with sensory data presented to them. Hence, it is to this work that I now turn.

(1) Bruner's work on perception:

Bruner's major research in this area took place during the late 1940's and the 1950's and established him as one of the first-rate experimenters in dealing with factors interfering with 'normal'perception. Allport, who deals both with Bruner's early theory of perception as it developed in the early 1950's "Directive State Theory," and its later development into what Allport called "Hypothesis Theory", classifies Bruner essentially as a nativist.[2] That is, Bruner is seen by Allport as maintaining that there are certain features in the act of perceiving which are innate and relatively unchangeable. As will be seen later, Bruner regards perceiving, as taking place

within a spatial framework, as one cognitive structure which appears to be innate. The first of these theories, the Directive State Theory, maintains that certain organismic factors dominate stimulus factors in perception. Examples of such organismic factors include the elements of the perceiving mechanism as such, e.g. the receptors and the nervous system components, and such idiosyncratic facts as a person's needs, values, tensions, and past experiences. According to Bruner and his associate, Postman, such factors enter into all perceptual experience to some degree or other.[3]

According to Allport, the central notion of the second position taken by Bruner, the position of Hypothesis Theory, is this:

> The basic idea underlying the reformulation by Bruner and Postman was that all cognitive processes, whether they take the form of perceiving, thinking, or recalling, represent 'hypotheses' which the organism sets up, or that are evoked by the particular situation. These hypotheses, in perception at least, are largely in the background and are usually unconscious. They require 'answers' in the form of some <u>further</u> experience, answers that will either confirm or disprove them. Adjustment of the organism to the environment proceeds by this process of hypothesis-confirmation or rejection....When we perceive, think, or remember we are evoking and testing organismic hypotheses.[4]

That is, Bruner maintains that every person forms certain hypotheses concerning his experience and has certain expectancies which will guide him in the selection of relevant cues in any perceptual experience. Such hypotheses and expectancies, which coordinate a person's needs, fears, ideas, etc., guide his perceptual experience. Thus, according to

this theory, perception is a subjective and cognitive sort of process since the key factor in determining what a person perceives is not what is actually 'out there' but the hypothesis (-es) which the individual is actively entertaining.

Here the question naturally arises concerning the theoretical justification for introducing the notion of 'hypothesis'. Admittedly this notion has the character of being a theoretical construct insofar as we cannot directly observe the hypothesis-generating process, particularly in the case of perceiving. Conceivably, Bruner could argue in one of two ways. Either he could argue on the basis of the stimulus information which the perceiver receives, or he could argue on the basis of the response the perceiver makes to the stimulus-as-perceived-by-the-experimenter. Bruner has chosen the latter path. That is, he presents the subject with a constant series of stimuli, and the series of responses this series generates, with respect to different subjects, determines the inference to the specific hypothesis with which the subject is operating.[5] In such a way, Bruner argues, we can indirectly observe the hypothesis involved in terms of what information is actually selected by the subject out of the total information presented to him.

Moreover, not only do these experiments reveal the hypothesis which is operative, they also often reveal the kind of strategy the subject is using. Bruner defines "strategy" in the following manner:

> A strategy refers to a pattern of decisions in the acquisition, retention, and utilization of information that serves to meet certain objectives, i.e. to insure certain forms of outcome and to insure against certain others.[6]

Examples of such strategies would be: 1) the strategy of the "simultaneous scanner", which employs each instance encountered as an occasion for deducing which hypotheses are tenable and which are to be eliminated; 2) the strategy of the "successive scanner" which involves the testing of a single hypothesis at a time; 3) the "conservative focus strategy" which involves finding a paradigm instance which is then used as a focus, other instances being measured against this focus; or 4) the "focus gamble" which employs one positive instance as a focus but which involves switching more than one attribute at a time. In terms of the relative usefulness of these strategies, Bruner clearly regards the second as the least productive and economical. The fourth may be the most productive but it may also turn out to be the least economical depending upon the gambles that are made. The first is extremely difficult and it would appear that, if asked to select one of the above, Bruner most frequently would choose the third kind of strategy since each successive instance encountered by the subject will provide information of some sort or other.

It is clear, however, that in each of the above sorts of strategies, universal properties of the data come into play. This is clearly the case in the first two but it is also the case with respect to the last two strategies since the

instance selected is not picked for its uniqueness but rather because it exemplifies the attributes primarily sought after. That is, Bruner's work with perception is highly compatible with his more comprehensive work on thinking and the unifying notion is that all thought processes, beginning with perception, show a concern with universal aspects of experience. As Bruner has again reiterated in a later essay entitled "The Perfectibility of Intellect":

> The models or stored theories of the world that are so useful in inference are strikingly generic and reflect man's ubiquitous tendency to categorize. William James remarked that the life of mind begins when the child is first able to proclaim 'Aha, thingumbob again.' We organize experience to represent not only the particulars that have been experienced, but the classes of events of which the particulars are exemplars. We go not only from part to whole, but irresistably from the particular to the general. At least one distinguished linguist has argued in recent times that this generic tendency of human intellect must be innately human, for without it one could not master the complex web of categorical or substitution rules that constitutes the syntax of language -- any language.

Moreover, Bruner continues,

> Both in achieving the economy with which human thought represents the world and in effecting swift correction for error, the categorizing tendency of intelligence is central -- for it yields a structure of thought that becomes hierarchically organized with growth, forming branching structures in which it is relatively easy to search for alternatives.[7]

From my exposition of the above features of Bruner's work on percpetion, it is possible to say that, for the epistemologist, various themes stand out. First, Bruner clearly maintains that perception is concerned with universals, that it is concerned with features of experience which can be predicated of many things. Secondly, Bruner is committed to viewing the fundamental object of perception as being essentially propositional in character. That is, in contrast to those philosophers

and psychologists who maintain that we perceive, at least sometimes, a pure, isolated sense datum, the linguistic referent of which is a single term in the language, Bruner argues that, in perceiving, we are essentially involved in the confirming and disconfirming of hypotheses which may refer to factual states of affairs. The linguistic referent of facts is commonly assumed to be a statement or set of statements. For example, if we hypothesize that we are seeing a red piece of paper on a green background, then that experience is best described in terms of a statement rather than a phrase insofar as we are involved in relating the position and color of the paper to that of its background. Given, then, that perceiving is essentially propositional in nature, as Bruner would seem to hold, perceptual judgments will always be open to error and the notion of incorrigible sense data is eliminated from one's epistemological framework.[8] Thirdly, it is clear that, for Bruner, perceiving is essentially an inferential process. As Wohlwill expresses this aspect of Bruner's position, he says it is:

> ...a point of view diametrically opposed to the Gestaltists, one which regards perception as basically an inferential process in which the perceiver plays a maximal--and maximally idiosyncratic--role in interpreting, categorizing, or transforming the stimulus input.[9]

And, as seen above, Bruner maintains that almost all perceiving involves the move from inferring from the presence of a particular feature or set of features, the identity of the perceived object in question. As Bruner states,

> Perception involves an act of categorization... the nature of the inference from cue to identity in perception is in no sense different from other kinds of categorical inferences based on defining attributes...there is no reason to assume that the laws governing inferences...are discontinuous as one moves from perceptual to more conceptual activities.[10]

In short, Bruner holds that in all human cognitive functioning inferential mechanisms are at work and perceiving is no exception in this regard.

Bruner's early work on perception has been criticized in that some developmentalists such as Wohlwill argue that Bruner's theory of perceiving presupposes an adult perceiver to the extent that Bruner assumes that the perceivers' conceptual categories are fairly well established. Bruner has dealt with this criticism in two different ways. First, his work since 1960 has taken a conspicuous and decided developmental turn and, second, he has denied the above criticism. There is evidence for this second point in Bruner's lectures in 1968 on infancy. In those addresses given at Clark University, Bruner stated:

> I shall assume...that cognition--the achievement, retention, and storage of information--is inherent and imminent in the functional enterprises of organisms. It can never be studied independently of the decisions that organisms take or evolution takes collectively concerning the grammar or logic of action.[11]

Although what Bruner means by the "logic or grammar of action" remains far from clear (and will be discussed in Chapter III), it is clear from these lectures that Bruner views even the 3-month old infant as possessing within himself the necessary

hypothesis-generating mechanisms which are called into play as he tries to cope with and coordinate his experience in increasingly powerful and efficient ways. That is, Bruner holds that hypothesis-generation is present as soon as the infant begins to function cognitively in any way at all. And, as we shall see below, the end product of this process of cognitive development is the emergence of a world-model, a kind of super-hypothesis which, in principle, coordinates all the varying aspects of an individual's experience and which enables him to generate more hypotheses concerning the nature of his future experience. Or, as Bruner states it,

> ...it becomes necessary for the learner to reduce the strain and potential confusion of receiving and processing input. He does so by developing strategies for using his limited capacities. This type of strategic learning is characteristic of every level of information handling--from eye movements (discernible in the very young infant), through perceptual structuring, to thought and problem solving.[12]

As this last passage mentions "levels of information handling", it is now germane to turn to Bruner's views concerning cognitive <u>development,</u> views which, when translated into educational practice, have revolutionized the thinking of many North American educators. This is not to say, however, that Bruner's educational influence stems only from his later work. Rather, given his views concerning perception and the continuity of perception with higher-order cognitive activities, I argue that it is not surprising that the so-called "discovery approach" should be championed by Bruner because, in essence,

this approach relies heavily on inferential hypothesis-generation by the student or learner, such generation being the fundamental mechanism in all cognitive functioning, according to Bruner.

(2) Bruner's views concerning cognitive development:

Although at times Bruner eschews the language of stages and prefers to speak in terms of cognitive growth[13], he does appear to use the terms "growth" and "development" interchangeably. Moreover, the way he speaks about cognitive development would appear to commit him to the fundamental tenets of a developmental theory, as outlined in Chapter I. First, he states that,

> It is curiously difficult to recapture preconceptual innocence. Having learned a new language, it is almost impossible to recapture the undifferentiated flow of voiced sounds that one heard before one learned to sort the flow into words and phrases. Having mastered the distinction between odd and even numbers, it is a feat to remember what it was like in a mental world where there was no such distinction. In short, the attainment of a concept has about it something of a quantal character.[14]

Moreover, Bruner quotes Neisser with approval, the latter claiming that not only are the experiences of childhood incompatible with the cognitive structures of the adult but that it is no longer possible for the adult to assimilate experiences in the same way as the child. As Neisser puts it, "This means that the universal amnesia for childhood is not primarily the result of anxiety or guilt, and is not based on an active process of suppression. It is, instead, a necessary conse-

quence of the discontinuities in cognitive functioning which accompany growth into adulthood."[15] Thus, although Bruner places stress on the possibility of operating with varying modes of representation, he also agrees that, to some extent, cognitive development is irreversible.

Secondly, in the essay entitled "The Perfectibility of Intellect", Bruner clearly states that intellectual growth does not appear to be smooth and continuous but, rather, occurs "...in spurts of rapid growth followed by consolidation."[16] Such consolidated plateaux, which are reached after these spurts, would appear to be like the Piagetian stages, only in different linguistic guise. Hence, I would argue that Bruner clearly falls into the developmental category.

Turning specifically now to Bruner's theory, one finds that he maintains that:

> ...mental development involves the construction of the model of the world in the child's head, an internalized set of structures for representing the world around him...[17]

This view is amplified in Bruner's important address to the American Psychological Association in 1964 entitled, "The Course of Cognitive Growth".[18] Here, as elsewhere[19], Bruner sets forth three levels of mental representation of the world: enactive, iconic, and symbolic. Underlying all three is the assumption that all cognitive activity begins with a process of classification of experience into various categories. The form and medium in which these categories are manifested

determines the dominant level of operation at which a specific individual is operating.

(a) Enactive Level:

At this level, according to Bruner, an individual processes information about the world primarily through actual bodily interaction with the world. For example, through actual manipulation and action on the bodily level, we come to master certain skills as riding a bicycle, knitting or driving a car. Similarly, we accustom ourselves to physical locations -- we can move around our homes in the dark without colliding with furniture even though we would probably be unable to describe verbally where all the furniture is located. For Bruner, this is the most basic manner in which we learn to process information and, chronologically speaking, it appears to be the first manner in which infants process information. Frequently lacking, even in the adult, any form of verbalization or visual imagery, this level is called "enactive" because the body itself retains the information. Thinking and acting are not separate activities at this level.

(b) Iconic Level:

The iconic mode of representation is more efficient than the enactive since it summarizes events in terms of perceptual imagery.[20] Providing greater conceptual freedom than enactive representations, images correspond to perceptual events in a more conventionalized way than do actions. This, essentially, is the power gained in moving at the iconic level rather than

at the enactive level. Concerning the limitations of this level, however, Bruner says,

> ...children who use an iconic representation are more highly sensitized to the spatial-qualitative organization of experience and less to the ordering principles governing such organization. They can recognize and reproduce but cannot produce new structures based on rule.[21]

Further limitations of this level are: 1) that it is highly subject to the influence of affect; 2) that it is still very closely related to action; 3) it is concrete -- the child at this level is very much caught by the surface features of his experience; and, 4) that it highly egocentric insofar as the child is still the central referent in the system. One indication of this last limitation is that children operating at this level are unable to produce simple drawings depicting situations other than their own. If,for example, they are asked to draw a picture of a room from the point of view of someone entering the room, the drawing is still made in such a way that their own spatial location dominates. In the adult, since imagery essentially reproduces surface features, it tends to be misleading, although sometimes it far excedes the linguistic abilities of the adult speaker in, for example, works of art. As Bruner is fond of saying, Napoleon always said that a general who thinks in images is not fit to command.

The chief intellectual achievement for the child who has moved from the enactive level to the iconic level is that,

according to Bruner, we now have clear evidence that the child clearly distinguishes between himself and his environment, a distinction not operative on the enactive level. However, since there is such marked variability and reaction to irrelevant surface features, Bruner maintains that the child has discovered the world of appearance only and has not yet begun to distinguish between what is "real" and what is merely "appearance".

(c) Symbolic Level:

Bruner, like Piaget, regards the symbolic level as representing the most powerful way of dealing with the world of experience. As Bruner states,

> ...once the child has succeeded in internalizing language as a cognitive instrument, it becomes possible for him to represent and systematically transform the regularities of experience with far greater flexibility and power than before.[22]

Such a view concerning the powerful role played by language in governing the behavior of the organism aligns Bruner with such Russian psychologists as Vygotsky and Luria.[23] According to Bruner, at this level, a more hierarchical mode of classification begins to emerge which goes beyond mere perceptual inclusion. Through language, the child is able to become increasingly distant from the perceptual influences which dominated him at the first two levels. Furthermore, language allows him to deal with those realms of his knowledge which have no direct referent in immediate experience, i.e. all that he knows about the possible, the conditional or

hypothetical, and states referred to by counterfactual conditional statements. For example, language is important in arriving at knowledge about the ideal limits of classes of objects studied in the physical or social sciences such as ideal gases or, for example, in economics, the perfectly rational man. Moreover, according to Bruner, in mastering a language the child and the adult are literally invited to form new concepts since the combinatorial properties of language give them the instrument to form new sentences and new connections in the language.

Supplementing the above functions of language mentioned by Bruner, Anderson points out several more:

> Symbols not only function as the means of communication with other persons and thus make possible our social life, but they also act within the individual as triggers to set off responses, as tracking devices to control the direction of responses, as holding devices to store past experiences and incorporate them into the system, and as the manipulable carriers of meaning which make thought and problem solving possible.[24]

With respect to the future, Anderson says:

> Through their storage and carrier functions they become the devices by means of which we anticipate the future, become aware of purposes and goals, and are able to free ourselves from the immediate demands of the present.[25]

Indeed, once the child has achieved competence in a language, then Bruner will argue that he is able to function at the symbolic level although the extent to which he will actually do this depends largely on the culture in which he is raised. As Bruner puts it,

> One is thus led to believe that, in order for the child to use language as an instrument of thought, he must first bring the world of experience under the control of principles of organization that are in some degree isomorphic with the structural principles of syntax. Without special training in the symbolic representation of experience, the child grows to adulthood still depending in large measure on the enactive and iconic modes of representing and organizing the world, no matter what language he speaks.[26]

In short, this is the premise that the extent to which the developing human will achieve a high degree of power and control over his experience is dependent largely on the form of education that he receives. Hence, it is quite natural for Bruner to try to translate his views into actual educational practice.

At this point, it is relevant to distinguish between what Bruner maintains and what I have set forth as general characteristics of cognitive psychology. In Chapter I, I presented a highly Constructionist view wherein the cognitive psychologist was said to hold that all objects of experience, even at the highest level, were the result of constructive processes in the human organism. Bruner takes exception to this although he does speak frequently of our "constructing models of the world". Two important examples may be mentioned here. First, Bruner maintains that a spatial framework is innate in human beings. He says, "Anybody who has read the subtle accounts in von Senden's valuable book on restored sight of the congenitally blind will recognize the uniqueness of a spatial framework. It seems to be given in

the very nature of the visual modality and makes possible a perceptual locus."[27] That is, Bruner adopts a Kantian-like position in which spatial orientation is said to be the necessary pre-condition for any perceiving whatever, not the result of a series of perceiving acts. Secondly, Bruner maintains that some categories appear to be innate in human beings. He says,

> If linguistic categories organized in hierarchies are to have relevance to the 'real world' [sic], then experience itself must be organized into hierarchically organized categories. We know that the child's language is organized in this way, and we know equally well from experiments that his experience is not. I am prepared to believe that in the linguistic domain the capacities for categorization and hierarchical organization are innate and so, too, are predication, causation, and modification.[28]

Thus, although Bruner is a constructionist in many important respects, he also adopts a Chomsky-like approach to some crucial aspects of human cognitive activity.[29]

Returning to the notion of developmental sequence, one quite naturally asks what processes lead an individual from one level to the next. Unfortunately, Bruner is the first to admit that these processes are still less than completely obvious; rather, he refers to them as presenting "...the greatest thicket of psychological problems."[30] He does, however, maintain that underlying the drive to utilize modes of representation at one or more of these levels is the primary desire to learn of and master one's environment. Nevertheless, however pedagogically relevant this drive might be, it still

does not serve to explain psychologically why certain transitions occur at various ages or why this particular sequence from enactive to iconic to symbolic is the most likely one. For those answers, we are still waiting.

(3) Bruner's account of the emergence of the notion of "the world":

The extent to which Bruner is a constructionist can be clearly seen in his discussion of how the child learns to distinguish between himself and the world around him.

In this section, I shall utilize the following terms: "object", "physical world", "the world". I shall understand by those terms the following: "object" or "physical object" shall refer to three-dimensional objects in space which persist through time, however brief. Such objects are to be viewed as causally efficacious, publicly observable and mind-independent. The term "physical world" shall refer to the notion of a physical universe composed of physical objects standing together in causal relations in space and time, which are thought to be forming a coherent pattern of events independent of the mind. The term "the world" refers to those characteristics immediately cited above with respect to the notion of physical world but is broader in scope in the sense of including also social and cultural constructs, private events in individual people's lives such as thoughts, wishes, feelings, etc., and various claims concerning the existence of non-physical objects such as angels, Gods, spirits,

leprechauns, etc.

In general, for Bruner, development of the notion of "the world" involves the following process: moving from a very primitive discrimination of objects as existing independently of oneself to a highly sophisticated conceptual ordering of what is meant by the notion of an orderly universe of which oneself is a part. For Bruner, the earliest important stage in this development is discussed in his Heinz Werner lectures delivered in 1968.[31] In those lectures, Bruner contends that we can observe infants around the age of one year shifting from the enactive to the iconic mode of representing their experience. Concentrating on the transition phases between modes of representation, Bruner stresses the gradual emergence of a world-model. He agrees with the Piagetian notion of decentration and describes it as "... removal of the self from the position of being the sole origin and metric of space and spatial relations."[32] Such removal, visible in the one-year-old child, according to Bruner, begins to take place when the young child begins to develop ways of coping with his environment and processing the information received such that those ways are no longer dependent upon his own actions. And, as seen above, such action-independence is one of the hallmarks of operating in the iconic form of representation, the latter centering around the producing of images rather than specific bodily motions. As Bruner states,

> ...one of the principal steps forward in the development of any skill is the development of an objectivized image or representation of performance that permits one to 'get outside oneself'. It is this kind of decentering that constitutes the base for the further growth of childhood skills.[33]

That the young child is actually operating with an iconic mode of representation is evidenced by an experiment carried out by Bruner and his associates at the Center for Cognitive Studies.[34] This experiment involved the child in a perceptual situation in which an object's position (in this case, a cup) relative to the child's line of sight and his line of reach appear to be different. For the fourteen-month old child, his reaching motions are slow and deliberate and the perceptual conflict experienced by him in trying to reach the cup is evidenced by processes of eye shutting and gaze aversion while he tries to grasp the cup. Younger children, however, for whom the cup is also at eye level, try directly to grasp the cup without making adjustments for the level at which the cup itself sits and, consequently, knock it over. According to Bruner,

> What is so crucial about this sequence of events is that, with development, reaching is occurring in a represented space. It is not a case of action and the space within which it occurs being inseparable, as with the youngest child.[35]

For Bruner, this new experiencing of space is essentially a form of constructed space, a way of coping with spatial demands which appears increasingly detached from the position of one's own body in space. Thus, considering this first

phase of transition, from enactive to iconic functioning, Bruner does not concentrate on the origination of the notion of an independent physical object per se (as Piaget would do) but rather on that aspect of the notion of a physical object whereby certain independent spatial relations are attributed to the object, relations which, nevertheless, are still dominated by the position of one's own body.

As I have said above, for Bruner, the child's use of an iconic mode of representation is one which is still highly responsive to the surface perceptual features of the situation in which the child is operating. In order to become increasingly more independent of those fluctuating features, the child needs to learn to operate with a more highly symbolic mode of representation which, by virtue of its intrinsic remoteness, allows him to withdraw from those perceptual features which attract, and sometimes mislead, his attention. One of the functions of the development of a symbolic mode of dealing with information would be that, for the child and for the adult, it would serve as "...an internalized verbal formula that shields him from the overpowering appearance of the visual displays."[36] For example, only by withdrawing from the immediate perceptual attributes in a given situation will the child be able to see that a half-full barrel and a half-full thimble are equally full or that a pound of lead and a pound of feathers weigh the same. In such situations, the child must learn to resist the perceptual appearances, to

move beyond his iconic representation of the world.

Concerning the development of the concept of "the world", Bruner views the child as passing through various phases.[37] At first, very young children appear to be highly egocentric. In this phase, the child relies almost entirely on such perceptual attributes as color and size which relate directly to him as the center and the norm. As he develops, he begins to group objects on the basis of their functional properties. At first, this functionalism appears to be a kind of egocentric functionalism in the sense that the object is seen as possessing those functions which the child himself can do (or those which a person with whom the child is actually present can perform). Bruner sees this phase of egocentric functionalism as highly correlated with the child's increasing use of first- and second-person personal pronouns. Further experiments with older children concerning the process of grouping show that although the grouping may still occur on a functional basis, the functions involved appear to be more highly conventionalized rather than related to the individual child. Finally, older experimental subjects are able to group items on the basis of hierarchical classifications.

For Bruner, the child's acquisition and mastery of language is absolutely essential for arriving at the notion of "the world" in the fullest sense described above. This mastery appears to be unattainable before the early years of adolescence but it appears to be absolutely crucial. As Bruner

states,

> Somewhere between 12 and 14 years of age, with the development of the ability to reflect upon thought itself, the adolescent begins to show the marks of formal thinking. He is now ready to take his place as a scientist, a thinker, a spinner of theory. If before he was able to cope with most of the problems that were immediately before him, contained so to speak in the givens of experience, now the young human being is able to cope, too, with potential problems, with issues that are not evident in the data of immediate experience, with possibilities not yet encountered. At this point, man moves beyond the powerful logic of empiricism to the infinitely more powerful logic of propositions, from a world of things present to a world of things possible.[38]

That is, Bruner maintains that only through language will the child and the adult be able to achieve the necessary remoteness to reference that enables them to deal with things which are not physically present, with things which are remote in time and things which are viewed as open to manipulations and transformation by a human agent. Furthermore, insofar as some of the most outstanding intellectual achievements of the human race are based on notions which are highly remote from our immediate experience, for example, the origins of the universe, laws concerning the relationship of matter and energy, the nature of stars, etc., it would appear that linguistic development is necessary for the further evolution of more powerful ways of dealing with and understanding experience. Thus, it is clear that Bruner regards mastery of a language as a necessary pre-requisite to the full development of the notion of "the world", that until the child has mastered a language in a fairly sophisticated way we cannot expect him

to understand important aspects of adult experience, or at least important aspects of adult experience in a highly technological society.[39]

For Bruner, it is clear that not all young members of a given society develop in terms of this late stage, the symbolic stage. Indeed, the extent to which they do is largely dependent upon social institutions within the society. As he puts it,

> ...mental growth is in very considerable measure dependent upon growth from the outside in--a mastering of techniques that are embodied in the culture and that are passed on in a contingent dialogue by agents of the culture. This becomes notably the case when language and the symbolic systems of the culture are involved...[40]

The most important of these institutions, for this purpose, will obviously be the educational ones for, according to Bruner, it is their function to stimulate this cognitive development such that the child is eventually able to operate at the symbolic level. Hence, Bruner perceives a great need to extend his psychological research into the public area of education. As he succinctly states,

> ...I think a theory of development must be linked both to a theory of knowledge and to a theory of instruction, or be doomed to triviality.[41]

In the remainder of this chapter, I shall outline briefly various influential educational recommendations which Bruner has made and, in chapters III and IV, critically examine the theory of knowledge which is central both to Bruner's theory of development and his theory of instruction.

(4) Bruner's educational recommendations:

For Bruner, a theory of instruction differs from psychological theory in two important ways.[42] First, a theory of instruction is prescriptive; secondly, it is normative. The first of these apparently is synonymous with setting forth or prescribing the most effective way of achieving a particular knowledge or skill. That is, it is prescriptive from an instrumental point of view, not from the point of view of saying what knowledge or skill is most valuable. Secondly, by saying that a theory of instruction is normative, Bruner seems to be saying that it sets up standards of performance against which the performance of children and others being educated may be judged. These two functions are contrasted with the chief function of psychological theory, both developmental and learning, which is essentially that of describing.

The chief output from a theory of instruction appears to be the development of curriculum, this latter being understood to encompass all the instructional variables, not merely subject matter. That is, Bruner maintains that a curriculum reflects not only knowledge in terms of subject matter but also certain assumptions about the nature of the knower and also the nature of the knowing process. Hence, one sees the importance not only of psychological theory to educational theory but epistemological theory as well. I shall therefore consider Bruner's recommendations briefly in these three areas:

a) The Knower:

As one has seen in considerable detail, Bruner regards the human organism, the knower, as engaging in what has been called in the literature "epistemic curiosity" almost from the very moment of birth. Central to the entire process of cognitive development is the desire to know and cognitive behavior may alternatively be referred to as knowledge-seeking behavior. Furthermore, as seen above, Bruner regards such knowledge-seeking behavior, in all its forms, as essentially a process of hypothesis-generating which provides the individual and his society with increasing control and power over the environment through a reduction in environmental complexity. Moreover, in the cognitively developing individual, progress is marked in terms of the models of experience which the individual is engaged in building. This progress can be detected in two different ways. First, one can determine at what stage of representation an individual is functioning, viz. enactive, iconic, or symbolic. Secondly, one can determine, within those stages, which models are more accurate or more powerful in some respect from those which are less efficient. The picture of the knower which emerges from these remarks and those made earlier in the chapter is that the knower, operating on the symbolic level, is an organism actively involved in processing information received both from the environment and from data generated from the model which he already has constructed. The educational

implications of this are obvious: that the learner, both in the classroom and out, must be actively involved in that which he is learning insofar as knowledge-seeking is an active process not a passive one; secondly, educational progress will have to be determined in terms of the child's level of cognitive development at the beginning of the educational encounter--a reaffirmation of the need to take into account individual differences both in teaching and in evaluating; and, thirdly, probably the most effective way to approach a particular topic is to follow, in modes of representation, the cognitive stages which all children seem to follow. That is, Bruner strongly recommends that, in introducing new topics, the subject matter first be presented in terms of actual physical objects and their manipulation, secondly, in terms of diagrams, simple drawings, graphs, schemata, etc., and thirdly, in linguistic form. As Bruner puts it, "If it is true that the usual course of intellectual development moves from enactive through iconic to symbolic representation of the world, it is likely that an optimum sequence will progress in the same direction."[43]

b) <u>What is Known: i.e. the Nature of Knowledge</u>:

According to Bruner, "Knowledge is a model we construct to give meaning and structure to regularities in experience. The organizing ideas of any body of knowledge are inventions for rendering experience economical and connected."[44] Although

the exact referrent of the 'we' is not clear (i.e. whether it applies to each human being or experts in various fields), it is clear that knowledge is both an individual and a social product possessed by each cognitively-functioning human organism and by the totality of human beings processing information. The end product, according to Bruner, is a model of the world or, in the terminology developed in Chapter I, a master cognitive structure which relates all the strategies and information possessed by a given individual concerning himself and the nature of the world around him. Knowledge, then, is essentially a stored theory of the world.

That these stored theories of the world are, beyond the iconic stage, social in nature is attested to by two facts. First, the symbolic stage is essentially linguistic in nature and language is clearly a social invention which is somehow internalized by individual speakers. Secondly, in technical societies, the stored theories of the world are set down in terms of the findings of various disciplines. Hence, one finds Bruner stressing the need to teach the structure of the disciplines insofar as these disciplines are the most efficient way of communicating the societal development of world models.

Although Bruner has wavered on this point recently,[45] his stress on the notion of structure has virtually revolutionized thinking in the area of curriculum development in North America. For Bruner, the proper emphasis in education is upon the

students gaining the structure of knowledge. That is, the student should be given a sense of the fundamental ideas of a particular subject or discipline. Furthermore, the teacher should communicate the idea that each subject matter is a particular way of thinking about and dealing with categories of phenomena. Not only is each discipline a way of thinking but it is a structured way of thinking, that is, it involves a "set of connected, varyingly implicit, generative propositions" which are logically related in terms of implication and conjunction.[46] For Bruner, each discipline has its own structure and it is the task of leading scholars in various fields to assist in making those structures sufficiently explicit in order that they may be incorporated into curriculum at all levels. The task of the instructional theorist in this process is to discover the optimal ways in which the structure of a given subject can be converted into terms and modes appropriate for children at varying stages of cognitive development.

This emphasis on structure and its necessary relation to the child's own stage of cognitive development has lead to the dictum, now notorious, that the foundations of any subject may be taught to anybody at any age in some form which is intellectually honest. Underlying this claim is the fundamental assumption that the structure of any given subject can, in principle, be converted into a form which is appropriate to each stage of cognitive growth. Hence, no matter what stage the child is at, there exists, in principle, a mode of

representation which he can grasp in dealing with basic ideas in a given field. Education, then, consists in communicating the structural ideas of subject matter in progressively more complex forms until the third or symbolic stage is grasped. At each stage, however, the child possesses knowledge only if it is knowledge which is translatable primarily in his dominant mode of representation, the symbolic form being the most powerful of the three. Thus, we say that a child has gained knowledge in a certain area when he has mastered the way of thinking proper to certain categories of phenomena which has become the dominant way of thinking about those phenomena in his society, that dominant way being equivalent to the way scholars and experts in the area view the phenomena in question.

It should be obvious from these remarks concerning knowledge that Bruner's views are a variation on traditional analyses of the phrase "X knows p". Whereas philosophers have tended to accept the following analysis: "X knows p" implies:

a) X believes p;

b) p is true; and

c) X has adequate justification for believing p.

Bruner's account, as distilled from the above general exposition, may be analysed in the following manner:

"X knows p" implies:

a) X believes p insofar as X has constructed

p and appears to act as if he believed p;

b) p is true insofar as it satisfied one or more of the following ways of validating hypotheses:

   1) direct test by correspondence

   2) consistency with other hypotheses

   3) affective congruence, i.e. a feeling of subjective certainty

   4) reference to authoritative statements;

c) X has adequate justification for believing p because:

   1) X can generate further propositions from p, such propositions being open to validation in the form of b (1-4);

   2) believing p reduces the complexity in X's environment;

   3) believing p allows X to order and relate events;

   4) believing p allows X to establish links with other believed hypotheses, r,s,t, such that his experience appears to him to be more ordered and regular than prior to believing p.

Thus, it would appear that Bruner's account of knowledge is highly pragmatic in nature. First, he emphasizes that knowledge is the result of the organism doing something to its experience, and, second, possessing knowledge is equivalent to being able to do something with the initial transformation of experience; we cannot be said to know something unless we can use that information to go beyond that information. For Bruner, knowledge is <u>never</u> simply something passively received which can remain inert in the knower.

c) The Knowing Process:

Along with Bruner's stress on cognitive readiness and the importance of teaching the structures of the disciplines, the third important educational recommendation which has had wide-reaching effects has been Bruner's emphasis on the use of the discovery approach as the most effective way of coming to know.

Although the term "discovery" has come to mean different things to different writers in the literature,[47] Bruner himself defines "discovery" as:

> ...discovery, whether by a schoolboy going it on his own, or by a scientist cultivating the growing edge of his field, is in its essence a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to new insights...often it is not even dependent upon new information.[48]

By emphasizing the intrinsically personal nature of discovering, Bruner does not intend to eliminate the teacher in the classroom. Rather, he is pointing to the need on the part of the teacher to move away from an expository mode of teaching to one which is more concerned with active hypothesis-generation on the part of the student. The need to emphasize such a mode of teaching is the following:

> The most urgent need of all to give our pupils the experience of what it is to use a theoretical model, with some sense of what is involved in being aware that one is trying out a theory...we should somehow give to children a respect for their own powers of thinking, for their power to generate good questions, to come up with interesting informed guesses.[49]

That is, Bruner seems to view the development of autonomous, effective cognizers as the main goal of the educational process.[50]

In support of this stress, Bruner mentions four advantages of learning through discovering. First, training in the methods of discovery increases the intellectual potency of the student. Bruner frequently illustrates this notion by reference to the simple game of Twenty Questions. Some students come to this game with an attitude of what Bruner calls "episodic empiricism", others come with an attitude of "cumulative constructionism". The student who approaches the game the first way is likely to give simple hypotheses for his twenty questions, hypotheses which are not particularly related. Such an approach rarely leaves the student with very much other than disorganized information on which to base his next hypothesis. It is clear that such non-organization is highly deficient as an effective strategy.

The child or student who approaches the game from the constructionist position uses a very different kind of strategy. He asks questions in such a way as to impose and locate constraints such that hypotheses framed later in the game are based on connected information gained through the constraint type of questions. When he eventually frames his final hypotheses, this student will have a far more organized base on which to guess, a base deriving from his original strategy maneuvers. Relating these notions to the

discovery approach in general, Bruner holds that,

> Emphasis on discovery in learning has precisely the effect on the learner of leading him to be a constructionist, to organize what he is encountering in a manner not only designed to discover regularity and relatedness, but also to avoid the kind of information drift that fails to keep account of the uses to which information might have to be put. Emphasis on discovery, indeed, helps the child to learn the varieties of problem-solving, of transforming information for better use, helps him to learn how to go about the very task of learning.[51]

The second major advantage resulting from learning through discovery is the shift away from extrinsic rewards in education to more intrinsic kinds of rewards and the accompanying shift to intrinsic motivation. That is, Bruner maintains that when behavior patterns become more extended and competence-oriented, more complex cognitive structures come into play and behavior is essentially oriented from within the human organism. Rather than having learning be dependent upon such extrinsic rewards such as grades or gold stars, Bruner seeks internal reinforcement through intrinsic motivation. In the essay entitled "The Will to Learn", Bruner distinguishes four dominant motives of an intrinsic sort: 1) curiosity, which invites the student to become an active participator in the learning process; 2) the drive to achieve competence especially through intellectual mastery; 3) the drive to emulate a model through the development of indentification figures and "competence models" (a drive particularly important for the teacher); and, 4) the

motive for reciprocity whereby the child desires to enter into joint discovery projects with others.[52] Apart from stressing the fact that developing such motives and systems of rewards leads to a continued interest in learning which extends beyond the formal educational setting, Bruner points out that if the students are to learn extended episodes of subject matter, this effort of discovering will not be sufficiently rewarded by anything other than increased power and understanding.

The third major advantage from learning through discovery is that the student learns the heuristics of discovery. Although it is difficult to spell out the heuristics in any given field, Bruner is convinced that students, through repeated acts of discovery, will come to an awareness of the actual processes involved in their discoveries. Only through practice can the student come to acquire a sense of the relevance of data presented to him. Similarly, only through practice will anyone working in a given field arrive at a generalized style of solving the problems placed before him. Hence, says Bruner, it is crucial that the student should discover as much as possible for himself.

Finally, the fourth major advantage discussed by Bruner is that learning through discovery is an aid to conserving memory. For Bruner, there are:

> ...a myriad of findings to indicate that any organization of information that reduces the aggregate

> complexity of material by imbedding it into a cognitive process a person has constructed for himself will make that material more accessible for retrieval.[53]

Thus, one finds that the arguments for teaching for structure and teaching through discovery are closely linked.

It should be clear from the above discussion concerning Bruner's analysis of perception and his subsequent research on the nature of human thinking, that these views are fleshed out in educational form through the emphasis on discovery learning. That is, insofar as it is true that human beings are essentially engaged in a continuous process of hypothesis-generation and that this is an observable and cultural-independent observation, it is only reasonable to expect Bruner to advocate strongly those methods of teaching which are directed towards the enhancement and strengthening of the most fundamental mode of human cognition.

In summary of this chapter, then, I have sought to point out those themes in Bruner's psychological theory, both developmental and non-developmental, which are of central interest to an epistemologist. Secondly, I have sought to show how Bruner's educational recommendations concerning major epistemological issues are a direct outgrowth of his psychological research and cannot, with intellectual justice, be separated from them, as many educational writers have attempted to do. In the remaining chapters, I shall be concerned with the following issues: a philosophical examination

of the central notion of the structure of a discipline as this is understood by Bruner (Chapter III) and a philosophical examination of the correlative notion of the development of cognitive models, in particular, a world model (Chapter IV). Thus, Chapter III deals with the social, codified object of knowledge; Chapter IV deals with the problem of knowledge as an aspect of an individual organism.

CHAPTER III

In this chapter and in the succeeding chapter, I shall be involved in a critical evaluation of two of the most important of Bruner's doctrines. In this chapter, I shall examine the important educational recommendation that we are to teach the structure of the disciplines. In Chapter IV, I deal critically with the individual epistemological correlate of that discipline-structure, the model of the world which each of us constructs to deal with experience.

One writer has said, in commenting on Bruner's influence on educational practice, that Bruner has "yeasty" ideas. I presume that this means that just as growing yeast pushes its way through heavy, flat bread dough transforming it into a light, fluffy loaf, so, too, Bruner's ideas and their widespread implications have vitalized a hitherto very stagnant educational situation. I agree with this analogy and wish to carry it one step further. I wish to suggest, and hope to demonstrate in this and in the following chapter, that just as yeast produces this transformation by means of bubbles of hot air (carbon dioxide, to be specific) so, too, does much of the educational superstructure which has grown out of Brunerian assumptions find itself based, at least philosophically, on great bubbles of hot air. But so much for the analogy...

In this chapter, I advance and attempt to prove the following thesis: that Bruner's strong emphasis on teaching

the structure of the disciplines arises primarily out of the transferring of concepts and models proper to one school of contemporary linguistics, viz. transformational grammar; and, furthermore, that one cannot understand the underlying rationale for Bruner's insistence on this practice unless one is aware of this transference. In order to support and explain this thesis, I divide the first part of the Chapter into three sections: A. an introductory section wherein I classify Bruner as a cultural conceptual instrumentalist; B. an examination of Bruner's adoption of a model from linguistics; and, C. an examination of the meanings of the proposal that 'we ought to teach the structure of the disciplines'. The second part of the chapter, part II, is a critical philosophical examination of the ideas advanced by Bruner in the first three areas.

I

A. Bruner as cultural conceptual instrumentalist:

In general, an important distinction can be made between what might be called the psychological and the logical structure of human knowledge. This distinction is operative in at least three different areas: the elements of the structure, the process of organization of the elements, and the cognitive maturity of the content.

Concerning the first area, one can distinguish between logical and psychological meaning. The first, logical meaning, may be said to refer to the "...possible and non-

arbitrary relationships that are relatable on a nonarbitrary, substantive basis to a hypothetical human cognitive structure exhibiting, in general, the necessary ideational background and cognitive maturity."[1] The key feature here, of course, is the element of nonarbitrariness. The logical meanings involved in the structure are those which inhere in the actual relationships involved in the structure. The psychological meaning of the structure, on the other hand, is the meaning which it has for a particular individual or set of individuals and is often highly idiosyncratic. For example, the psychological meaning that a college physics text has for a fourth-grader is probably considerably less than the logical meaning of the actual text and area of study.

Secondly, one can distinguish between the psychological and the logical process of organization. We might organize our teaching materials on the basis of the laws of meaningful learning and retention and thus arrive at a psychological process of organization. This may not, however, be identical with the logical organization of the material derived from principles of deductive logic and based on reconstructions of the material. For example, a standard high school geometry text presents the subject matter almost solely in a logically deductive way whereas, for learning purposes, the entire order and organization may be usefully reversed. Hence, there does not appear, at least on <u>a priori</u> grounds, any reason to conflate these two processes of organization.

Thirdly, one can distinguish logical and psychological aspects of the cognitive maturity of a body of knowledge. That is, one can examine a body of knowledge from a psychological perspective in, for example, developmental terms, to see whether this material is aimed at children who might be operating primarily iconically. Or one can determine at what level of symbolic sophistication the material is aimed. Articles found in professional sociology journals, although dealing with the same topics found in the 7th grade social studies text, are of different levels of cognitive maturity. From a logical perspective, however, there does not appear to be any notion of developmental variability. Generally, in a recognized discipline, the cognitive maturity of the theories is constant and high since, as Bruner readily admits, the scholars and experts in various areas are the chief intellectual sources for the nature and character of the given disciplines.

Admitting these distinctions in these three areas is not, however, cause for despair among teachers and curriculum developers since there appear to be important links between the psychological and logical dimensions involved. And this is not surprising for there is an important interdependence between them. The logical structure of human knowledge, particularly as it is embodied in various disciplines, is the outcome of the collective psychological processes of human knowing. That is, the logical structure is a systematically

reconstructed body derived from the products of human knowing when that knowing appears to reach its most mature stages in the work of scholars in various areas. Furthermore, one says that an individual has become expert in a discipline only when his own psychological structure, his 'model', as Bruner calls it, stands in an isomorphic relation with the public, logical structure of knowledge. Hence, it is quite natural to expect that stress should be placed on teaching the structures of human knowledge as soon as possible in the child's education so as to narrow the gap between knowledge, in the public sense of a recognized discipline, and knowledge, in the private sense of the individual's own degree of mastery of the discipline.

For Bruner, the interdependence of these two dimensions is very strong. In short, Bruner maintains that, "... knowledge reflects the structuring power of the human intellect."[2] In a way, this remark is trivially true insofar as everything a human being does reflects some capacity or power of that human being, otherwise he wouldn't be able to do it. But Bruner wants this remark to be understood in a far stronger sense, viz. that we should use the structure of the disciplines as an inferential base upon which to argue about actual psychological processes of structuring. And, as shall be seen, the master discipline for this sort of inference is linguistics. As Bruner states,

If, then, the structure of knowledge has its own laws,

> a society with a language, myths, a history, and ways of doing things.[4]

In essence, then, it is clear that Bruner, in one fell swoop, rejects both the philosophical school of direct realism and any school of idealism in favor of some form of a representational theory of knowledge.

Moreover, it is important to emphasize the last sentence in the above passage because Bruner strongly emphasizes that each individual knower necessarily constructs his body of knowledge from the pool which is the body of knowledge of his culture. As Bruner points out, in the essay entitled "The Course of Cognitive Growth",

> Most of the innovations [in the growth of intellect] are transmitted to the child in some prototypic form by agents of the culture: ways of responding, ways of looking and imaging, and most important, ways of translating what one has encountered into language.[5]

Among the most powerful of these ways are the disciplines, the sophisticated and codified knowledge-products of the culture in which the individual develops. As will be seen in considerable detail below, this appears to be the essence of what it means for something to <u>be</u> a discipline, <u>viz</u>. that it be a powerful, public way of dealing with experience using a set of strategies which identify one as being a practitioner of that discipline. In short, disciplines are highly sophisticated cultural tools.

For Bruner, the strong interrelation between the individual and his culture is manifest in his espousal of what he

calls "instrumental conceptualism", a view which contains two chief tenets. The first tenet is this:

> (1) That our knowledge of the world is based on a constructed model of reality, a model that can only partially and intermittently be tested against input.[6]

This model is, for Bruner, subject to various constraints. First, it must embody those cognitive structures which appear to be axiomatic to any model one can construct. Such structures might be the structure of cause and effect and the structure of the continuity of space and time. Second, the model has various inherent physical and conceptual limitations given that human beings are organisms of a certain sort apparently capable of generating linguistic systems within a narrow range of the larger range of logically possible ones.

The second tenet is this:

> (2) That our models develop as a function of the uses to which they have been put first by the culture and then by any of its members who must bend knowledge to their own uses....models are first adopted from the culture and then adapted to individual use.[7]

That is, Bruner is maintaining that, in the strongest terms, the knowledge that an individual develops, the model he builds, will always be, in principle, derivable from the culture-model(s) and will always be a sub-model of that larger body of knowledge. As Bruner quite openly states, a distinction between cultural instrumentalism and individual instrumentalism can be made only analytically. What we are, and in particular, what we <u>know</u> will always be derived from the ways of looking

and thinking that are part of the culture in which we live.

Why suppose that there is such a model in each human being? And what are its fundamental properties? In response to the first question, Bruner argues that all his research, both in the area of perception and in the area of concept attainment, problem-solving and thinking, leads to the conclusion that human behavior displays a high degree of rational regularity in terms of the ways in which humans deal with experience. As Bruner puts it, "...one could discern systematic strategies in behavior that had the quality and creases of well practiced rule-governed routines."[8] Furthermore, says Bruner, the existence of those strategies necessitates the postulation of inner cognitive mechanisms for their explanation. That is, Bruner argues that we cannot explain the complexity and economy of human cognitive behavior unless we assume some underlying structure or structures which contain rule-like components. The most general of these Bruner calls a "model of the world". As he puts it,

> Man constructs models of his world, not only templates that represent what he encounters and in what context, but also ones that permit him to go beyond them...Both in achieving the economy with which human thought represents the world and in effecting swift correction for error, the categorizing tendency of intelligence is central -- for it yields a structure of thought that becomes hierarchically organized with growth, forming branching structures in which it is relatively easy to search for alternatives.[9]

Moreover, the central feature concerning this model, which I have referred to previously as the psychological correlate of

the structure of human knowledge in the public sense, is that it is predictive or, in Bruner's more recent terminology, generative. Human cognitive models are essentially devices by means of which we can generate predictions.

What does Bruner mean by a 'generative model'? And how is this related to the notion of generative grammars? The second question I deal with in part B of this chapter. The first one shall be dealt with here. There, unfortunately, is no clear, unambiguous answer to this question. In the essay, "The Course of Cognitive Growth," Bruner says, in one context, that, "the child...is translating redundancy into a manipulable model of the environment that is governed by rules of implication."[10] On the same page, however, he says, "But the models that the growing child constructs seem not to be anticipatory, or inferential, or probabilistic-frequency models. They seem to be governed by rules that can most properly be called syntactical rather than associative."[11] Moreover, in the essay entitled "Toward a Disciplined Intuition", Bruner states,

> ...when information is organized in terms of some generative model, it turns out that there are many things that follow from it in a way that verges on redundancy. While this is usually recognized in more structured subjects such as mathematics, it is not so generally recognized that any connected body of knowledge contains such redundant implications, even if in a less strict sense.[12]

It may be objected that in this last passage Bruner is referring to knowledge in the public sense but this objective is ruled out since, for Bruner, the properties of human knowledge are

the same whether speaking of individual knowers or of human knowledge in the collective, which is ultimately resolvable in terms of individual knowers anyway.

Hence, it appears that one can have at least three possible interpretations for what it means for a model of the world to be generative:

1) generative: in the sense of utilizing the rules of logical implication

2) generative: in the sense of using syntactic rules

3) generative: in the sense of implication in a less strict sense than in 1).

In short, Bruner does not appear to be using the notion of "generative model" in an entirely consistent fashion since it is clear that sense 1) and sense 2) are logically independent procedures. Also, it is clear that sense 1) and sense 3) are mutually exclusive uses of the term. These equivocations will be of major significance when I try to unravel the meaning of the notion, "the structures of the disciplines".

Furthermore, turning to the examples which Bruner provides when using these three senses,one does not find much further clarification:

Example of 1) "Alice is taller than Mary, Mary is taller than Jane" implies that "Alice is taller than Jane."

Clearly, this is a case of strict logical implication of the form: If pRq and qRs, then pRs, R being a transitive relation.

Example of 2) Children finding examples of steadying tools, a process parallel to Wittgenstein's explanation of how we form the concept of game

> in terms of 'family resemblances' and which Bruner describes as displaying the "syntactic nature of their behavior".[13]

Example of 3) Here Bruner asks, "What does one know, for example, about situations in which a group of people are being taxed by officials over which they have no electoral control or no other recourse? Surely, something more than that a popular cry of the Revolution was 'No taxation without representation.'"[14]

Clearly, there is no logical implication between knowing something about people, generally speaking, in this economic and political situation, and knowing the cry of the American Revolution. Moreover, one cannot derive the cry by means of any syntactic derivation. Unfortunately, with respect to this third example, Bruner appears unwilling to tell us what this "something more" is so that we are given no further clue as to the meaning of sense 3), particularly as Bruner clearly rules out association as one of the features of generative models, saying that we can "at our peril" call it association, if we like.

In relating the above comments to the topic of this chapter, it is to be recalled that Bruner perceives very little or no important difference in the way that knowledge is structured in the human knower and the way it is structured in the cultural institution of human knowledge which has become codified. Moreover, he maintains that whenever we are confronted with a set of facts or pieces of information, there are always ways of going beyond them since such collections,

"...have about them the character of a substructure." Or, in other words, the child should be lead to "recognize not only that he has a string of facts but that, put into some order, they generate more facts. This is the notion behind much recent urging that curricula be organized around the idea of the structure of a discipline."[15]

Thus, it appears, at this stage of the discussion, that Bruner examines human cognitive behavior, infers the presence of some sort of cognitive model in the mind of the knower, asserts that this model can be derived only from the master-model embodied in the forms of knowledge in the culture of the knower, and then infers that, since that model derives from individual knowers, properties seen in the master-model can be inferred to be present in the model(s) of individual knowers. Examining, then, the structure of human knowledge as found in terms of human disciplines can provide us with information and predictions concerning the nature of individual knowing subjects in that culture. Moreover, since the educational ideal is to establish a correspondence between the structure of the disciplines and the structure of knowledge in the individual, such cultural structures being justified on pragmatic grounds, it is quite reasonable to expect that educators in a given culture be urged to make the study of the structures of the disciplines the central feature of the curricula in that culture.

B. The importance of Bruner's adoption of a linguistics model:

In developing this idea, I shall follow this line of discussion: first, I discuss Bruner's views concerning the relation between language and cognitive structure and the extent to which he accepts a Whorfian hypothesis; second, I discuss the basic features of linguistic theory as outlined in a Chomsky-like theory of transformational grammar; thirdly, I discuss the extent to which, for Bruner, linguistics serves as a model for all disciplines; and, fourth, I discuss how Bruner transforms previously linguistic categories into innate conceptual categories thereby proposing essentially a Kantian view of the human subject.

As seen above in Chapter II, Bruner regards cognitive development as occurring in three forms of representation: enactive, iconic, and symbolic representation, the representation in each form being defined as "the end product of a systen of coding and processing."[16] In the remainder of this chapter, I shall focus almost exclusively on the last of these three forms of representation, the symbolic form, since it is clearly the most important for Bruner and because it is that form which is most often codified in the form of learned disciplines. Furthermore, although Bruner frequently says that language is merely the prototype of symbolic functioning, he has yet to come forth with some other clear case of symbolic, non-linguistic activity.[17] Hence, for my purposes and following Bruner's own practice, I shall assume an equivalence between the terms

"symbolic" and "linguistic" when used in the context of this chapter.

As seen in section A, Bruner argues from human cognitive behavior to the existence of internal mental structures. This same line of argument is present in the work of Noam Chomsky, a linguist from whom Bruner has derived many of his ideas concerning the structure of linguistics. In Language and Mind, Chomsky writes,

> Insofar as we have a tentative first approximation to a generative grammar for some language, we can for the first time formulate in a useful way the problem of origin of knowledge. In other words, we can ask the question, What initial structure must be attributed to the mind that enables it to construct such a grammar from the data of sense?.... We must postulate an innate structure.[18]

That is, Chomsky argues that the only way to explain the great disparity between a speaker's knowledge of his language and the actual, and meager, experience on which this knowledge appears to be based necessitates the postulation of innate cognitive structures for each speaker of the language. This is a line of argument directly parallel to Bruner's work with the exception that up until 1965 Bruner did not commit himself to the seemingly innate character of some of these structures. It now appears, in Bruner's more recent writings, that Chomsky's influence is being felt more and more.

Once Bruner has postulated the existence of some sort of cognitive structure, it becomes highly germane to ask what the relationship is between a person's competence in a given

language and his general store of cognitive structures. In determining Bruner's answer to this question, it becomes clear that although Bruner rejects the lexical version of the Whorfian hypothesis, he clearly ascribes to what might be called the "syntactic version" of that hypothesis. In the essay entitled "The Control of Human Behavior", Bruner states,

> ...language learning is also concept learning, and the price one pays for the gift of language is that one also learns to operate in terms of the concepts that are codified in a language--all the concepts of relationship, of modification, of cause and effect. I am not supporting the so-called strong form of Whorf's hypothesis--that language ineluctably molds the shape of thought and certain ways of arranging the shared subjective reality of a linguistic community.[19]

That is, Bruner is arguing that one's language somehow conditions the style "and structure of thought and experience."[20] Moreover, Bruner maintains that thought processes as such are nothing more than internalizations of social and public discourse. Hence, it would appear that although Bruner <u>says</u> that he ascribes to a "weak" version of Whorf's hypothesis, he interprets this version in a very strong and robust fashion. That this is so can be seen from the fact that not only does Bruner think that language influences <u>individual</u> thought processes but that it conditions the entire identity of a person. For example, he says, "The shape or style of a mind is, in some measure [Bruner's occasional disclaimer], the outcome of internalizing the functions inherent in the language we use."[21] Thus, not only does Bruner agree with Luria and Vygotsky about

the regulatory role played by language in terms of our acts of perception and our behavior but holds that it provides an internal technique for programming "...our forms of awareness."[22] Although the phrase "forms of awareness" is admittedly vague, it is clear from the context that Bruner is referring to something far broader in scope than isolated bits of behavior which have been the subject of much of Bruner's own empirical research in this area.[23]

Since Bruner accepts some version of Whorf's hypothesis, it becomes relevant to discover precisely what those "features inherent in the language" are that hold such sway over our cognitive processes. In discussing this issue, it is first necessary to clarify some of the terminology to be employed in this discussion as many of Bruner's comments assume at least an acquaintance with the language of linguistics, in particular,the work of Chomsky, Fodor, and Katz.

As Fodor and Katz have stated in their seminal essay, "The Structure of a Semantic Theory",[24] the fundamental question in constructing an adequate theory of grammar is this: What does the speaker know about the phonological, syntactic and semantic structures of his language which enables him to use and understand any of its sentences, even those he never previously heard? Whatever specific form the answer to this question takes in a given language, it seems clear that it will be composed of sets of rules which the competent speaker uses in generating new sentences in his language and judging

novel sentences which he has not previously encountered, the underlying argument being that such phenomenal capacity of the speaker to deal with an infinite set of sentences presupposes rules which describe which are permissible utterances in the language.

It is customary among linguistics to distinguish among three distinct elements of a complete theory of generative grammar: 1) a syntactic component; 2) a phonological component; and 3) a semantic component. The function of each of these is the following:[25]

syntactic component: a set of rules which generates strings of minimal syntactically functioning elements (called "formatives") and specifies the categories, functions and structural interrelations of the formatives and systems of formatives

phonological component: a set of rules which converts a string of formatives of specific syntactic structure into a phonetic representation

semantic component: a set of rules which assigns a semantic interpretation to an abstract structure generated by the syntactic component

Further terminology which is necessary for the discussion which follows is:

"surface structure" = syntactic structure in terms of its phonetic representation

"deep structure" = the semantic interpretation of the abstract, syntactically generated structure

"C-terminal strings" = generated strings of formatives which are the basis of deep structure

"T-Terminal strings" = derived strings which appear as actual sentences in the language as the result of syntactic transformations

"Transformations" = complex grammatical operations which match various parts of the C-Terminal strings into derived or T-Terminal strings

"Transformational History" = the set and sequence of operations which a specific C-Terminal string has undergone

A linguist is said to hold to a transformational approach to syntax, for example, if he maintains that for each actual sentence in a given language, it is possible to trace through various complex operations which have been performed on an initial C-Terminal string to produce the actual given sentence, the latter possessing a different syntactic structure than the original C-Terminal string. These transformations, however, are not regarded as performed on actual sentences in the language but on fundamental structures which, when operated upon in various ways, generate the actual sentences of the language. In short, then, the notion of "grammatical structure" is a theoretical notion with no observable referent in the language and which signifies that deep or underlying structure which, when transformed, generates the surface structure which takes on a phonological representation. For purposes of this thesis, the important element to note is this: that throughout these transformations, linguists such as Chomsky maintain that certain mental operations are going on in the heads of speakers of the language under discussion,

operations which are given the title of "grammatical transformations". Hence, a cognitive dimension is explicitly assumed in the work of Chomsky, Fodor, and Katz.

In his essay, "A Transformational Approach to Syntax",[26] Chomsky cites at least twenty-three classes of transformations which can be performed on deep structures to yield sentences with different surface structures. Although the transformations cited[27] apply specifically to English, Chomsky does not commit himself to the exact number to be involved in English, nor does he maintain that these can be found only in English. Obviously, the transformation which yields the passive form of a sentence can be found in at least all the Indoeuropean languages.

Turning specifically to the notion of a "generative grammar" as this has been developed by Chomsky and other transformationalists, it appears that this notion means that there exists in each language a set of operations which, when applied to individual C-Terminal strings, yield T-Terminal strings or actual sentences in the language. That is, given a set of rules and an individual sentence, one can generate or produce a large number of sentences by means of carrying out various mental operations with respect to the initial sentence. This is most obvious, argues Chomsky, in the area of syntax and a semantic parallel has yet to be developed. Chomsky believes that the latter theory is possible but that it will

be far more complex than the syntactic structures. Given, then, that a semantic theory is still in the distance, it is clear that syntactic structures alone will not suffice to allow us to distinguish between semantically meaningful and semantically nonsensical sentences in the language. And this is a point of central importance. Comsky himself, in Syntactic Structures, provides examples in which the grammar plus the transformations produce nonsense, although the utterances are well-formed from a syntactic point of view.[28] For example, he proposes the sentences:

1) Colorless green ideas sleep furiously.

2) Read you a book on modern music?

3) The child seems sleeping.

all of which Chomsky claims to be grammatical but nonsensical. From this he laments that, "Such examples suggest that any search for a semantically based definition of "grammaticalness" will be futile."[29] And, of course, the obvious corollary of this is that a search for a syntactically based definition of 'semantic meaningfulness' is also doomed to be a futile one.

Turning now to Bruner's discussion of "generativity", one finds that although he professes great allegiance to Chomsky, he also distorts the notion of generativity. In the essay entitled "Patterns of Growth", Bruner says,

> ...[symbols] are always highly productive or generative in the sense that a language or any symbol system has rules for the formation and transformation of sentences that can turn reality over on its beam ends beyond what is possible through actions or

> images. A language, for example, permits us to introduce lawful syntactic transformations that make it easy and useful to approach declarative propositions about reality in a most striking way.

That is, in this passage, Bruner equates "generative" with "being highly productive". Secondly, he maintains that the generative property is central to any symbol system whatever and, as shall be seen, this includes disciplines as well since, in linguistic form, they are a subset of some given language. Thirdly, Bruner, in keeping with his constructionist viewpoint, does not distinguish between "turning reality over on its beam ends" and transforming statements concerning reality. That is, insofar as what is real is a product of the human mind, then it is consistent to speak of transforming reality by means of the generative property of language.

Three features of language or symbol systems are thought by Bruner to be crucial: 1)the remoteness and arbitrariness introduced by use of a symbol which bears no direct resemblance to its referent (e.g. the world "Philadelphia" bears no direct resemblance to the city bearing that name); 2) the combinatory productiveness of language (e.g. "Philadelphia is a lavendar sachet in Grandmother's linen closet" or $(x + 2)^2 = x^2 + 4x + 4 = x(x+4) + 4$); and 3) the transformational property of language (e.g. the transformations of the passive, the negative, and the query: The man was bitten by the dog, The dog did not bite the man, Was the man bitten by the dog?). For Bruner, the rules of grammar contain both

properties 2) and 3). And, like Chomsky, he maintains that "... the grammar of a language...is...the set of rules that will generate any or all permissible utterances in that language and none that is impermissible."[31] Furthermore, "...the rule-bound nature of grammar assures that the child will be able to produce an endless number of utterances of a syntactically legitimate nature and will, moreover, produce none that is not."[32] Given, then, that an individual is able to transform sentences, Bruner maintains that,

> ...these powerful productive rules of grammar are linked to the semantic function as well--to the 'real world' [sic]; that is to say, having translated or encoded a set of events into a rule-bound symbolic system, a human being is then able to transform that representation into an altered version that may but does not necessarily correspond to some possible set of events.

Although Bruner acknowledges his theoretical debt to Chomsky,[34] he then proceeds to move far beyond anything Chomsky and other transformationalists have proposed. Bruner maps syntactic transformations onto conceptual categories in the following way, maintaining that since all languages have various transformation rules, speakers of various languages will also operate with various universal conceptual categories. The mapping looks like this:

syntactic structure		conceptual category
verb-object	⟶	cause-effect
subject-predicate	⟶	function
modification	⟶	intersection of classes

Two other conceptual categories which do not have merely a single linguistic correlate are the categories of categorization and hierarchical organization. Here Bruner maintains that certain ways of organizing experience are innate[35] and that these innate cognitive processes are reflected in the syntactic structures of one's language. Moreover, Bruner maintains that these Kantian-like categories are the "... minimum properties of any symbolic activity" and that "...any symbolic activity, especially language is logically and empirically unthinkable without these properties."[36] That is, Bruner moves from an examination of the transformational properties of language as set forth in terms of formal syntactic structures to infer conceptual categories which match those transformational operations and then claims that such conceptual categories are a necessary condition for operating in any way that is properly symbolic. Hence, the fundamental task for the developing child is, if he is to operate at the highest mode of cognitive functioning, that "...he must first bring the world of experience under the control of principles of organization that are in some degree isomorphic with the structural principles of syntax."[37]

In addition to the categories cited above, Bruner mentions two others which, in addition to the above, form the axiomatic base for any cognitive model we might develop: the idea of the continuity of space and time, and the idea of invariance in

experience.[38] Furthermore, Bruner holds that these categories are present in those techniques which humans use for representing the world, in particular, the symbolic techniques. A corollary of this, again, is that these categories will be operative in specific intellectual disciplines. As Bruner states,

> Again we feel that there are many exercises that can have the effect of leading the child to recognize not only that he has a string of facts but that, put into some order, they generate more facts. This is the notion behind much recent urging that curricula be organized around the idea of the structure of a discipline.[39]

Moreover,

> The matter goes well beyond that. Indeed, well short of a 'discipline', most collections of givens have about them the character of a substructure which, when sensed, provides the way of going beyond the information given.[40]

Hence, it would seem that Bruner is maintaining that a generative model can be found in every collection of information and should be most prominent in those collections which we have labelled "disciplines". Also, it would seem from the above that once we are in possession of certain facts, we can generate more facts from those already known. That is, we can always utilize some generative model to go beyond the information which we are already given.

On the basis of the above remarks, then, I would argue that Bruner clearly adopts the notion of a generative model from linguistic theory, extends it to all forms of cognitive

functioning since he maintains that certain properties of cognitive functioning are innate and universally present, and then translates it into educational policy in the form of advocating that we teach the structure of the disciplines as the most efficient way of transmitting the most powerful generative models found in the culture. That is, I am arguing that Bruner takes over the notion of language learning as the paradigm for all learning[41] because all disciplines are subsets of the basic language in a given culture. This will become clearer as I now move to a discussion of the various meanings which Bruner actually attaches to the notion "structure of a discipline".

C. Bruner's interpretation of the notion "structure of a discipline":

In the essay entitled, "After John Dewey, What?", Bruner sets forth his most cogent argument for teaching the structure of the disciplines.[42] That argument runs as follows:

P_1 One's view of the nature of knowledge determines the issue of subject matter in education.

P_2 Human knowledge is essentially constructive in nature, that is, knowledge consists of inventions we make in order to make sense out of our experience.

P_3 Culture develops primarily through producing more and more powerful systems of ideas which provide greater comprehension and greater instruments for coping with experience.

P_4 Disciplines are codified forms of these cultural tools which are the most powerful tools we have on the cognitive level.

P_5 Education, primarily in technological societies, should provide those tools by means of which the society can further develop.

C_1 Since, by P_4, disciplines are the most powerful tools, their transmission is the proper subject matter of education.

P_6 The underlying structure of the disciplines is what gives them their force, both cognitively and pragmatically.

C_2 Hence, the structure of the disciplines is the proper emphasis in education.

Given that this is a fair reconstruction of Bruner's basic argument, it becomes my central concern now to try to elucidate precisely what Bruner understands by the phrase "structure of a discipline", keeping in mind that, for Bruner, any specific discipline is but a subset of the broader cultural construct, the language of the society, and that whatever properties pertain to language and language-learning also apply to disciplines <u>per se</u>.

Returning briefly to the notion of cognitive structure, one finds Kessen defining it in the following way:

> To say that a particular mental structure was operative would be to say that a set of transformation rules--a theory-- exists which permits the prediction of outcome on the presentation of certain information or stimulation.[43]

As should be obvious from the preceding remarks, Bruner accepts this definition and externalizes it to apply to public

cognitive structures, e.g. disciplines, as well. Again, one sees that the notion of transformation rules is central to the notion of structure. As I have argued above, since Bruner maintains that language learning should be regarded as the paradigm for the learning of structures, this leads him to argue, for example, in the essay "Patterns of Growth" that disciplines are essentially "...powerful systems of notation and ordering."[44] That is, Bruner seems to regard disciplines as systems of notation just as mathematics or ordinary language provide methods of notation and ordering. The upshot of this, then, is that learning a discipline is, in essence, learning a new language and, given Bruner's adherence to the Whorfian hypothesis, learning a new mode of thought.

More specifically, in dealing with the notion of structure, one can distinguish three, logically independent, senses of the term "structure": 1) the content sense, 2) the methodological sense, and 3) the attitudinal sense.[45] As shall be seen below, all of these senses can be found in Bruner's work.

1) The content sense:

In the book, The Process of Education, one finds Bruner saying that to emphasize structures is "...to give a student as quickly as possible a sense of the fundamental ideas of a discipline."[46] In this passage, Bruner uses the term "structure" as equivalent to "fundamental ideas of a discipline". Later on, however, in the same volume, one finds Bruner saying

that such projects as those emerging from the University of Illinois Committee on School Mathematics and the Physical Science Study Committee, are "...excellent instances of the well-conceived sequence designed to lead the student to an understanding of basic ideas and structures."[47] Here it would seem that Bruner is distinguishing between basic ideas and structures. Still again, Bruner says that, "...the curriculum of a subject should be determined by the most fundamental understanding that can be achieved of the underlying principles that give structure to that subject."[48] Hence, one is given a general understanding of the content sense of structure: that it refers to basic ideas or to structures in the sense of the relations among the basic ideas or to underlying principles. Nevertheless, underlying all these possibilities is the assumption that whatever the structure is, it is singular for each subject matter.[49] That is, Bruner holds that physics has a structure, biology has a structure, history has a structure and that literary criticism has a structure.

In some of his later writings, Bruner probes considerably further into this notion and, reflecting the influence of various linguists, refers to the "deep structure of any given discipline". This notion is further defined in the following way:

> Knowledge has a structure, a hierarchy in which some

he says that, in education, "...the most urgent need of all is to give our pupils the experience of what it is to use a theoretical model, with some sense of what is involved in being aware that one is trying out a theory."[55] Concerning this latter notion, I think that it is fair to say that Bruner espouses a form of Operational Constructionism with respect to theories. In its most general sense, theory building, or structure building is, for Bruner, "...creating a shape of nature."[56] This comes through most clearly, argues Bruner, if one looks at examples of theory building in the sciences. For example, he says,

> ...much of what we speak of as knowledge in science is indirect, we talk about such things as pressure or chemical bonds or neural inhibition although we never encounter them directly. They are inferences we draw from certain regularities in our observations. ...We wish to transmit the idea that there are certain observations we make or operations we perform that turn out to be quite regular and predictable. We weigh things or study the manner in which our instruments move under set conditions. "Pressure" is the construct we invent to represent the operations we perform and the regularities in experience that occur when we perform them. Does pressure exist? Well, yes, provided you have invented it. [57]

On the basis of this sort of passage, it would appear that Bruner is clearly maintaining an operationalist view of the meaning of theoretical terms. This view is, however, somewhat at odds with a parallel discussion concerning the neutrino. In this context, Bruner says,

> The nuclear physicist creates such empty categories out of the requirements of a theory of the nature

> of matter: for the nucleus of an atom to behave as it is supposed to behave, there must be a small particle with neither positive nor negative charge, a neutrino. The neutrino is created as a fruitful fiction. And in time a neutrino is found. But a comparable creation in art does not follow the necessities of strict logical implication.58

Here it would appear that Bruner is hedging a bit for although he does hold that theoretical notions are operational constructs he is not maintaining here that the term "neutrino" refers to certain operations being carried out, for example, in a Wilson cloud chamber or under an electron microscope. He is, it seems, clearly maintaining that the existence (in some sense) of the neutrino and its main properties are logically deducible from certain behavioral properties of the atomic nucleus. On this basis, then, one can say that although Bruner does hold that each subject matter has its own inherent structure, given the operationalist constructionist bent which pervades Bruner's work, this inherent structure is essentially man-made and may bear little relation to existing structures in the world. It is this man-made structure which is to be communicated when we teach the structure of the various disciplines.

Were this the only sense of "structure" which Bruner uses, one could now proceed immediately to a philosophical examination of this notion. Unfortunately, however, this is not the only sense of the term nor is it even clear that, for Bruner, it is the most central sense. Recalling his emphasis on the transformational nature of all human learning, it is

only natural to expect that he will add a more active dimension to the above notion of "structure". This leads, then, to a consideration of the second major sense of "structure", the methodological sense.

2) the Methodological sense of "structure":

This second sense of "structure" grows out of Bruner's oft-repeated slogan that knowing is a process, not a product.[59] Translated into educational form, this means that when one teaches structure, one is teaching students to participate in a process. That is, Bruner seems to be saying that knowledge and knowing is essentially a matter of acquiring certain skills, not storing pieces of information, and that disciplines are essentially "ways of thought", ways of carrying out various cognitive operations. That these "ways of thinking" are essentially different from structure understood in the content sense is obvious from the following passage where Bruner says,

> Underlying a discipline's 'way of thought', there is a set of connected, varyingly implicit, generative propositions.[60]

That is, Bruner holds that part of a structure is its content but more important than the content are the ways in which it goes about utilizing this content. Emphasizing this sense of the notion of structure has led Bruner to say that a man is not educated if he does not have some sense of what knowing is like in some field of inquiry and apparently this "sense of knowing" is equivalent to being able to carry out inquiry

in the way proper to a given field. For example, Bruner says,

> For whatever the art, the science, the literature, the history, and the geography of a culture, each man must be his own artist, his own scientist, his own historian, his own navigator.[61]

Underlying this entire methodological sense is the assumption that what the expert practitioner in a discipline does and what a neophyte does in learning that discipline are, in essence, the same activity although one is more sophisticated than the other. How does one figure out what is involved in being, for example, a physicist or a mathematician? To this query, Bruner responds that, at least for mathematics, "the great concepts of arithmetic are parts of the tool kit for thinking. They contain heuristics and skills that the child has to master."[62] Hence, it would appear that at least in some cases, the concepts themselves indicate the ways to go about practicing in a given discipline.

Teaching structure, in this second sense, then, means teaching students how to do certain things in certain ways which are the same as those who professionally operate in various disciplines perform. However, in order to carry out those activities in a genuine way, Bruner maintains that certain attitudes are necessary as well as performing certain cognitive activities. This leads, then, to the third sense of the notion of "structure".

3) the Attitudinal sense of "structure":

This third sense is also introduced in The Process of Education. In discussing the problem of translating structure into material which is suitable for a given level of cognitive development, Bruner states,

> The problem is twofold: first, how to have the basic subjects rewritten and their teaching materials revamped in such a way that the pervading and powerful ideas and attitudes relating to them [my underlining] are given a central role...[63]

Even more explicitly, in the essay, "The Perfectibility of Intellect" Bruner states:

> The disciplines of learning represent not only codified knowledge but ways of thought, habits of mind, implicit assumptions, short cuts, and styles of humor that never achieve explicit statement.[64]

Thus, it is not sufficient to teach merely how to be a physicist and the underlying ideas in physics but one must also teach various attitudes as well. Unfortunately, as Bruner points out, these attitudes never achieve explicit statement so it is not clear in precisely what way one is actually supposed to teach these attitudes. One way which Bruner alludes to is that we should give students the attitude that they are capable of solving problems on their own. Another attitude which should be conveyed, says Bruner, is that just as "...a physicist has certain attitudes about the ultimate orderliness of nature and a conviction that order can be

discovered, so a young physics student needs some working version of these attitudes if he is to organize his learning in such a way as to make what he learns usable and meaningful in this thinking."[65] Just how this particular attitude is related to being a productive physicist is not explained in any way by Bruner.

Before turning to my critique of these three senses and the underlying picture of language which is central especially to the first sense, I shall examine, very briefly, the examples of structure which Bruner himself discusses. Four such examples are drawn from biology, mathematics and literature. In discussing biology, Bruner says, "...one of the principal organizing concepts in biology is the persistent question, 'What function does this thing serve?' -- a question premised on the assumption that everything one finds in an organism serves some function or it probably would not have survived."[66] In mathematics, on the other hand, the three fundamental ideas are: commutation, distribution, and association. Armed with these three, says Bruner, students should be able to recognize seemingly new equations as variants of ones already mastered. That is, structure in mathematics consists, in part, of these three concepts.

Turning to Bruner's literary examples, these are a bit more puzzling. Concerning a novel, Bruner says that, "If a novel is put together with no necessary relation between

one set of events and others, then surely it is a poor novel."[67] Again one finds that structure in this instance consists of questions such as : Why is the crew all pagans? What if they had all been New Bedford Puritans? Why is the whale white and the crew pagan? Also, concerning a play, Bruner asks, "Can the third act drift off independently of the first two? Likely not."[68] That is, Bruner does not give a specific example here but he suggests that somehow there are some constraints imposed which are internal to the work of literature and which provide it with structure both of style and of content.

Finally, turning to the actual course which Bruner and his colleagues have set up entitled "Man: A Course of Study", one searches long and hard for the discipline or singular structure underlying this course. And this is not surprising for Bruner draws from sociology, linguistics, a philosophy of tools, and psychology in order to deal with what he calls the content of the course, man: his nature as a species and the forces that shaped and continue to shape his humanity.[69] Moreover, Bruner readily admits that, "The choice of topic is partly fortuitous -- in the sense that it reflected the interests and knowledge of those of us who were involved."[70] Thus it would appear that with respect to this course there is no singular underlying structure other than the topic of the course itself.

I shall return to Bruner's selection of examples and examine them from a more critical perspective immediately below.

II

Philosophical Critique of Bruner's Account of the Structure of a Discipline:

In this section, my criticisms will follow a parallel line of exposition as that followed in part I. That is, I shall offer some criticisms of Bruner's use of a linguistics model, then criticize the notion "structure of a discipline" as this is understood by Bruner, and, finally, evaluate the usefulness of the examples which Bruner proposes.

A. Criticism of the Linguistics Model:

Concerning this first area, I have two major criticisms. First, as seen above, Bruner maintains that "...strings of facts, put into some order,...generate more facts."[71] Presumably this is the direct parallel to the following: given a set of C-Terminal strings, by means of transformations one can generate sets of T-Terminal strings. Or, equivalently, from a given syntactically well-formed sentence in a language, we can trace through its transformational history and on the basis of various transformations produce other sentences which begin with the same deep structure. But here is where the parallel seems to end. Apart from the vagueness of the phrase "put into some order", the analogy breaks down at a

crucial point. As seen above, manipulating syntactic structures and transforming them does not guarantee that one will always produce semantically meaningful utterances. Similarly one might argue, contra Bruner, that from various facts, one might, depending upon what the reference to "order" suggests, generate falsehoods or statements which, while not factual in nature, are not falsehoods either. (Here one might think, for example, of statements of idealizations.) This is particularly the case if Bruner is willing to admit as one transformation that which negates the original utterance. Granted that from a given sentence one can generate its negation, this would then be good reason to suspect that one was not generating a fact but very likely a non-fact (assuming that the original sentence was factual in nature). Furthermore, all this talk about facts is very confusing. It is quite understandable how a linguistic utterance can generate another utterance but how does one fact generate (in a non-causal way) another fact?

Secondly, I find an underlying confusion in Bruner's thinking in this area. By relying so heavily on mathematics learning and language learning as his paradigms,[72] Bruner seems to be reducing the notion of subject matter to that of the notion of a system of notation. That is, I interpret Bruner as saying that disciplines or subject matters, particularly when expressed in symbolic form, possess all the

properties which pertain to language or systems of notation in general. But surely this doesn't automatically follow.

Consider the following counter-example: As seen above, Bruner regards the concept of causation to be embodied syntactically in the verb-object relationship. But it would appear conceivable that a discipline could contain sentences utilizing the verb-object syntactic form but not, in any direct way, employ the notion of causality. In fact, this is precisely what seems to be the case in some branches of sociology where practicing sociologists eschew all talk of causation in favor of that of correlation. Here one could maintain the verb-object form without being committed to causal language. For example, the demographer who reports that sixty-five percent of white, middle-class Canadians own television sets would utilize the verb-object form without implying that "owning a television set" is a causal relation. In short, I am arguing that when utilizing a linguistics model for the paradigm of learning all structures, including those of actual disciplines, Bruner is prone to committing a fallacy of division by simply assuming that all those properties pertaining to language in general apply to specific subsets of the language. Rather, it would appear that he needs to demonstrate this, in specific cases, not simply postulate this of all such subsets.

B. Criticism of Bruner's Interpretation of "Structure of A Discipline":

Turning specifically to Bruner's remarks concerning the notion of the structure of a discipline, I have several comments to make.

(1) It appears to me that Bruner's language directly commits him to the view that there somehow is, inherently present, a singular structure for each individual discipline.[73] But take, for example, different systems of geometry generated out of various forms of denial of Euclid's fifth postulate. Here it would appear that different structures, in the content sense, are generated from different starting points and that the most reasonable thing to say would be that geometry possesses many alternative structures and that there simply is no one structure which is "inherent in the material".[74] If multiplicity of structure is admitted with respect to such a highly formalized discipline as geometry, then it should be even easier to imagine cases of multiple structures in areas in which such formalization is absent. For example, suppose one sociologist argues that a functionalist theory is that structure which is "inherent in the nature of the phenomena" while another argues that a conflict theory best represents that structure. Clearly both satisfy Bruner's standards for economy and generative power because they are invoked to explain much of the same data but it again appears that here there are clearly at least two structures in operation. When

one turns to history or to literature, Bruner's argument for singularity becomes even more suspect. Experts in the fields disagree about structure and one wonders why Bruner is so insistent on this point other than from the point of view of pedagogical simplicity.

(2) I have great difficulty in deciding precisely what in Bruner's work is the basic unit from which more facts and information supposedly can be generated. Were one to adopt wholeheartedly the linguistic paradigm, then, to be consistent, one would suspect that the sentence or proposition would be the basic unit in the given subject matter. But that does not appear to be the case. In the essay, "Art as a Mode of Knowing," Bruner says,

> Any idea, any construct or metaphor, has its range of convenience or its 'fit' to experience, and this is one feature that art and science as modes of knowing share deeply. A concept like 'parthenogenesis,' for example, fits certain reproductive phenomena in biology but fails to fit or predict others.[75]

I find this very puzzling. How can one generate anything from, for example, the concept "chair" simply taken in isolation? Certainly one cannot make any predictions with existential import simply from an examination of the concept (unless one somehow adopts a Leibnizian position that all truth is analytic, and even then, existence claims are not part of the concept of anything other than the concept of God.) How, without some relational propositions, can one relate chairs

to tables, to stools, to building materials,etc., unless one has a congery of concepts to deal with? I do not know where to begin to understand Bruner's own examples here. If, in fact, I am correct in arguing that Bruner is holding that the concept is the main generating element, then this marks a significant departure from the dominant tenets of that linguistic model with which Bruner is usually operating and, hence, renders him open not only to the charge of obscurity, but also to that of inconsistency.

(3) I think that Bruner, when speaking of the generative power of the structure of a given subject matter, confuses the notion of transformation, understood in the linguist's sense, and the notion of logical deducibility. First, the notion of logical deducibility is not a notion which is entirely clear because what is regarded as logically deducible from what will depend, to some extent, on the system of logic which one chooses to adopt.[76] Furthermore, once adopted, the logical system, being solely formal in nature, is applicable to an indefinite number of languages. This is not the case, however, with syntactical transformations which are language-specific and which do not appear to be arbitrarily imposed on the language but can be discovered in the language itself. In addition to being language-specific, the number of unique transformations which can be carried out with respect to a given deep structure is probably finite in number (Chomsky has

arrived at only twenty-three classes for English) whereas the number of logical operations, while often trivial, is indefinite, particularly if the logical system employed contains the notion of disjunction. Hence, I would argue that there is a fundamental confusion in Bruner's use of the notion of generativity and that the two senses, viz. transformation and logical deducibility, which can be distinguished are fundamentally logically independent in their outputs from an identical starting point.[77] Hence, when the teacher walks into the classroom prepared only with the intention of getting the students to generate new data, there is bound to be confusion because two very different sorts of cognitive operations are being masked by use of the same word.

(4) In The Process of Education, Bruner says that, "To learn structure, in short, is to learn how things are related."[78] Similarly, in the same volume, he says,

> ...in order for a person to be able to recognize the applicability or inapplicability of an idea to a new situation and to broaden his learning thereby, he must have clearly in mind the general nature of the phenomenon with which he is dealing.[79]

Hidden in these remarks is a fundamental lack of clarity concerning two key terms, "things" and "phenomena". The lack of clarity is this: do these terms refer to actual things such as physical objects outside somehow in the 'real' world or do they refer to conceptual matters? That is, is the first quotation really saying, "To learn structure is to learn how

things are really related to each other" or is it saying, "To learn structure is to learn how things have been conceptually related by human beings."? Given Bruner's operationalist-constructionist position, it would appear that he would be committed to the latter formulation but that interpretation would argue against the second passage which clearly does not use the notion of concepts and does stress the actual application of ideas in existing situations. Furthermore, the second or non-constructionist interpretation would be more in keeping with Bruner's belief that structures are singular and are somehow inherent in the subject matter and, hence, are relatively permanent such that they can be made the basis of at least a twelve-year spiral curriculum.[80]

Therefore, concerning these passages, I would argue that since one cannot clearly determine which interpretation of these passages is the correct or more adequate one given Bruner's general position, one cannot discern Bruner's final position on this fundamental epistemological issue. Again, confusion results for the teacher because he does not know whether to expose students to actual, existing empirical things or to theories which have been constructed by human beings to somehow deal with those things. One would suspect that in some cases direct exposure to the object might lead to a clearer conception of the general nature of the phenomenon than would the encounter with a theory which purports to deal

with classes of phenomena. Sometimes Bruner argues along these lines; at other times, he takes just an opposite line. Obviously, greater clarification is called for here.

(5) Here I wish to examine Bruner's claim that "Effective power will, to be sure, never exceed the inherent logical generativeness of a subject."[81] It appears to me that this claim is either very misleading or false. First, it is misleading because, in a trivial way, the logical generativeness of a subject is essentially unbounded and, hence, it is not clear how anything could exceed this since, in principle, we could always generate one more sentence through logical means. It also appears to be misleading insofar as it suggests that logical generativeness is somehow inherent or innate in a given subject. As I argued above, logic, understood as a formal system for deducing propositions, can take many forms, none of which is so inherent in the material that, given another system, the subject could not be structured differently from a logical point of view. I also tend to think that in at least one important way the claim might be false. Consider the case of utilizing powerful metaphors and analgies, for example, thinking of a society as a living organism. Certainly here one cannot <u>logically</u> (in the strict sense) deduce anything about societies from various facts about living organisms but, having adopted this analogy, the logical implications of theories of natural organisms are extended to apply to societal

groups. In this case, it would appear to me that this is an instance where effective power does exceed the inherent logical generativeness of a subject (assuming that one can give some meaning to this latter notion). Furthermore, this seems to me to be quite an acceptable method of teaching because very often analogue models such as the above prove to be very fruitful in arriving at further discoveries in the original subject matter under discussion.[82]

(6) Here I wish to return to Bruner's remarks concerning the constructive nature of theories and, in particular, his remarks concerning the discovery of the neutrino. The remarks which will be under discussion are the following:

> The nuclear physicist creates such empty categories out of the requirements of a theory of the nature of matter: for the nucleus of an atom to behave as it is supposed to behave, there must [sic] be a small particle with neither positive nor negative charge, a neutrino. The neutrino is created as a fruitful fiction. And in time a neutrino is found. But a comparable creation in art does not follow the necessities of strict logical implication.[83]

The first question I wish to raise concerning this passage is this: what does it mean to say that "in time a neutrino is found"? Given Bruner's strong operationalist tendencies, one would think that he would say, rather, that our instruments register certain numbers and patterns and that this set of instrumental data is what we mean by "neutrino", not something "out there". Further, Bruner does not appear to distinguish clearly between the concept of "neutrino" and neutrinos per

se, that is, in the sense of independently-existing physical objects. In what sense is a neutrino, in the latter sense, created by physicists? And if neutrinos are created, how could we tell the difference between that experience of theory construction and the "finding" of a neutrino? I do not see that Bruner has any clear answers to these queries since he frequently conflates the conceptual order and the existential order.

The second question I wish to raise about this passage is this: in what way does the creation of the neutrino follow the necessities of strict logical implication? In arguing in this way, Bruner seems to assume that from a body of data, one explanatory hypothesis can be deduced. But that is simply false. From a given body of data an indefinite number of explanatory hypotheses can be proposed such that the body of data follows, logically speaking, from them. That is, the data, 'q' can be the consequent of an indefinite number of conditional statements $p \supset q$, $p_1 \supset q$, $\ldots . p_N \supset q$. Moreover, starting with 'q', one cannot uniquely deduce any of the above 'p's'. Certainly at the time of the proposal of the neutrino-hypothesis, other explanatory hypotheses were proposed as well to explain the data at hand. In short, Bruner's remarks here are very misleading and, with respect to this last point, simply false.

Finally, concerning this passage one might ask the same sorts of questions concerning Bruner's own work both in the

area of cognitive psychology and his more epistemologically-oriented work. Bruner himself certainly does not seem to think that cognitive processes are "fruitful fictions" nor does he think that the notion "structure of a discipline" is an invention but rather is something which is inherent in the subject matter itself. It is curious that when Bruner is carrying out his own research, his remarks in that sort of context bear little resemblance to the slight degree of existential import which he accords key terms in other theories.

In summary, then, concerning this first sense of structure, I have set forth the following criticisms:

(1) questioning the supposed uniqueness of the structure;

(2) maintaining that there is a fundamental lack of clarity regarding Bruner's discussion of the basic generating unit in a structure;

(3) pointing out a fundamental ambiguity concerning the notion of "generative power";

(4) maintaining that there is a basic conflation of the conceptual and existential orders in Bruner and a resulting confusion concerning what is really known or can be known;

(5) that the term "effective power" requires greater clarity than Bruner gives it;

(6) that, contra Bruner, unique hypotheses cannot be deduced from empirical data.

Given these fundamental deficiencies concerning the first sense of the phrase "structure of a discipline" I would argue that although Bruner's surface description appears unproblematic, it contains many areas in which crucial epistemological issues

knowing single concepts, as Bruner would suggest, but upon experimenting with different techniques utilizing large bodies of concepts. Secondly, I am very puzzled about how the single notion of commutativity can create a way of thinking about number that is "...immensely generative...". My remarks above concerning the difficulties of generating from single concepts apply here as well. Moreover, I fail to see how a single concept can create an entire way of thinking about number. How does this take place?

If, however, concepts do not generate heuristics, then I fail to see any justification for Bruner's moving from the content sense of "structure" to the methodological sense. Finally, concerning the last sentences in this passage, I might simply point out that the statement, "Without the idea of commutativity algebra would be impossible.", if taken at face value, is simply false. Counter-examples to this are not rare since a great deal of Group Theory deals with sets and operations that are specifically non-commutative. Furthermore, many of the complex operations performed in matrix algebra are manifestly non-commutative. Hence, it is not clear in what sense algebra really would be impossible without the idea of commutativity.

Concerning the attitudinal sense of "structure" I have only one comment to make and that is that Bruner is not very clear here about the sorts of attitudes he really has in mind.

In some of the examples cited, particularly in The Process of Education, Bruner states that the important attitudes to inculcate are those which are directed toward learning, such as confidence in one's ability to carry out problem solving. In other contexts, however, he seems to be referring to beliefs which stand in a kind of meta-relation to the disciplines themselves such as a belief in the orderliness of nature, as pertaining to a physicist. Again, if one is striving to teach those attitudes which are part of the structure of a discipline, it is difficult to tell precisely what those attitudes are, at least on the basis of Bruner's remarks.

C. Criticism of Bruner's examples:

Turning to Bruner's examples, I have only two comments to make. First, concerning his discussion of the novel, Moby Dick, and the structure of plays in general, Bruner claims that, "If a novel is put together with no necessary relation between one set of events and others, then surely it is a poor novel."[87] Granted, it might be a poor novel, but that is not equivalent to its being an unstructured novel. Furthermore, given the wide variety of contemporary literary styles, a novel which appears to be rather structureless by Bruner's standards may be a very good novel indeed.

Secondly, Bruner is simply in error when he talks about necessary relations between sets of events. No single set of events logically necessitates any other set of events.

I suppose that Bruner could push the example into the extreme by describing a situation in which each word was written in a different language, no character ever appeared for longer than a single page, the context shifted from paragraph to paragraph, plots began but were never continued, etc., but this situation would be quite ridiculous and would, of course, lay Bruner open to the charge of committing a black-and-white fallacy by arguing that the situation so described is the only alternative to a highly structured novel.

Secondly, concerning Bruner's own course: Man -- A Course of Study, it would appear that he is quilty of violating many of the canons he has established for the actual setting up of the teaching of the structures of the disciplines. He appears quite eager to admit that "The choice of topic is partly fortuitous -- in the sense that it reflected the interests and knowledge of those of us who were involved."[88] Nevertheless, Bruner warns professional educators to act in precisely the opposite sort of way, to appeal constantly to the experts in a given discipline, not across a multitude of disciplines as Bruner's own course would suggest. Furthermore, an examination of the outline of the course fails to reveal any clear-cut overriding structure, particularly not one which is inherent in the subject matter itself. Bruner borrows many theories from areas in which there is a great

deal of expert controversy regarding those theories, particularly those drawn from the social sciences.

Thus, with respect to Bruner's own examples, I would argue that they are not particularly illuminating and that, in some instances, they appear to contradict some of his more general remarks concerning the teaching of structure, assuming that one can attach determinate meanings to this latter notion.

III

In this chapter, then, I have, first, introduced basic distinctions which are operative when discussing the notion of a structure of a discipline. Secondly, I have tried to show how, in very important ways, Bruner adopts the linguistic model of transformational grammar and extends it into the area of codified human knowledge in general. I then examined various meanings of the phrase "structure of a discipline" and proceeded to offer various philosophical criticisms of Bruner's discussion, criticisms which call into question the validity of advocating this widespread curricular and pedagogical practice if such practice arises out of Bruner's arguments and relies on them for its ultimate justification.

Chapter IV

Having discussed Bruner's views of the public object of knowledge, the disciplines, I now wish to turn to the private epistemological correlate, the model or models which each individual knower constructs to deal systematically with his experience. As seen in the above chapters, Bruner's works are replete with discussions of the following notions: structure, internalized structure, structure of a subject matter or discipline, internal representations, patterns, rules, grammars, and systems. And, as a general rule, many of these notions are present in all those works of Bruner having definite educational import, as well as in his more straightforward psychological work. There is, however, one recent addition to this list and this is the introduction of the notion of model, a notion which only begins to figure prominently in Bruner's works of the 1960's.[1]

In order to examine the significance this term has for Bruner, I first cite key passages in which Bruner employs this term. This is section I. I then examine the work of various philosophers who, very recently, have sought to provide clarification with respect to the kinds of contexts in which it is proper to use the term "model" and the kinds of commitments one makes thereby. In this section, section II, I follow the exposition given by Peter Achinstein.

> (4) We know now...that experience is not to be had directly and nearly, but filtered through the programmed readiness of our senses. The program is constructed with our expectations and these are derived from our models or ideas about what exists and what follows what. (OK, 120)

In this book, On Knowing, Bruner slips in the term "model" with little fanfare. This is not, however, the case in the book, Toward a Theory of Instruction (hereafter TI). In the opening essay, "Patterns of Growth", the possession of a model is said to be one of the benchmarks of the nature of intellectual growth. In this context, one finds Bruner saying (in italics, nonetheless):

> (5) Growth depends upon internalizing events into a 'storage system' [sic] that corresponds to the environment. It is this system that makes possible the child's increasing ability to go beyond the information encountered on a single occasion. He does this by making predictions and extrapolations from his stored model of the world. (TI, 5)

And, in the important essay, "Notes on a Theory of Instruction", Bruner says,

> (6) The achievement of more comprehensive insight requires, we think, the building of a mediating representational structure that transcends such immediate imagery, that renders a sequence of acts and images unitary and simultaneous. The children always began by constructing an embodiment of some concept, building a concrete model for purposes of operational definition. (TI, 65)

Hereafter, I shall refer to these passages by number, one to six, respectively. At present, I shall not seek to clarify or provide interpretations of these passages. Brought into direct proximity they will be left to radiate and mutually to

reenforce their vagueness for a few more pages. In my search for some tools of interpretation, it now becomes necessary to turn to the writings of contemporary philosophers of science who, though concerned primarily with the use of models in science, discuss the topic of models in general.[2]

II

Although there are differences of detail among various philosophers dealing with the topic of models, I shall adopt the following classification of models which has been proposed by Peter Achinstein in Concepts of Science.[3] Achinstein distinguishes three broad classes of models: (1) Representational models; (2) Theoretical models; and, (3) Imaginary models. I discuss each of these briefly.

(1) Representational Models:

Representational models are those models which first come to mind when one is asked to think of models. For example, tinkertoy models of molecules, models of various systems found in science museums, model airplanes, trains, boats, etc. are examples of representational models. Within this class, one can distinguish four kinds of models:

a) true models: models in which all the important characteristics of the prototype are reproduced in the model to a set scale so that examining the model enables one to determine certain facts about the prototype;

b) adequate models: models in which only some of the many relevant characteristics of the prototype are reproduced so that only some of the characteristics of the original can be discovered through manipulation of the model;

c) distorted models: models in which some or all the characteristics of the prototype are reproduced but with differing scales so that various conversion factors are required to move from aspects discovered with respect to the model to aspects of the prototype;

d) analogue models: models in which the model-prototype relation results from two essentially different systems being employed and with certain analogies being drawn between them with the further condition that one system be studied, experimented with, calculated upon in order that the other system be better understood. (For example, an engineer may solve problems about an acoustical system by using an analogue model of an electrical network, solve problems with respect to the network, and then convert the solution back to the original system.)

Common to all representational models is the requirement that they represent accurately, at least in part, some of the characteristics of the prototype. Even though this involves certain simplifications and approximations, it nevertheless sets rather severe limits on the amount of alteration that will be tolerated since such models are used in science as the basis for calculations and inferences regarding the properties of the original. In all four cases, the model is something non-verbal even though, in case d), it may simply be described and not actually constructed. But the model in

case d) is not the description itself but the system described.

In the educational setting of the classroom, the functions of representational models far exceed the single role cited for representational models within scientific contexts. For example, a model airplane may be utilized for calculation purposes in the classroom but other functions may enter in as well. A teacher might employ such a representational model in a social studies class in which the pupils study various modes of transportation and their respective personnel. Or model airplanes could be used to represent various stages of technical development commencing, for example, with models of the early Wright Brothers' planes. Clearly one can multiply the roles of representational models in the classroom and this multifunctional capacity may be one reason for the popularity of such models for both teachers and students.

(2) Theoretical Models:

A second important class of models is that of theoretical models. Standard illustrations of such models are the following: the Bohr model of the atom, the free-electron model of metals, the billiard ball model of a gas, various models of learning behavior, and the Keynesian model of economic activity.[4] General characteristics of theoretical models are the following:

a) they involve a set of assumptions about some object or system which will often involve the use of some mathematical equations;

This first characteristic would seem to equate theoretical models with theories but, as will be pointed out, there are important differences between such models and theories, especially with regard to their truth claims.

b) such models often involve, in their descriptions, the attribution of certain inner structures, compositions or mechanisms which are intended to explain various properties which the object or system exhibits;

For example, the billiard-ball model of a gas attributes a molecular structure to gases; the corpuscular model of light attributes a particle composition to light; and the Bohr model of the atom attributes an underlying structure to the hydrogen atom.

c) they are simplified approximations useful for certain purposes (a characteristic which leads us to evaluate theoretical models both in terms of their usefulness in deriving important relationships and in terms of their completeness and accuracy of representation);

Characteristic c) thereby allows for the multiplicity of models related to the same set of phenomena. Each model may be invoked with a different purpose in mind and nothing more is claimed than this model is useful for a specific purpose. Finally,

d) theoretical models usually are proposed within the context of some more basic theory or theories.

For example, the billiard ball model of a gas is proposed within the context of Newtonian theory; the Bohr model is

proposed within the framework of classical mechanics and electro-dynamics. In addition, theoretical models are developed occasionally on the basis of an analogy with some different object or system. For example, the liquid-drop model of the atomic nucleus is compared with the analogy of the division of a liquid drop into two smaller drops. However, this characteristic, d), need not be present in theoretical models.

On the basis of the above discussion, Achinstein is in a good position to distinguish between theories and models. As this will be relevant when I return to Bruner, I shall cite these differences here. The first of these concerns the degree of veridicality claimed for the set of assumptions involved. When one speaks of or proposes a theoretical model, he is aware that his assumptions are limited in many ways and that allowance is made for deliberately simplifying and thereby falsifying devices being employed. According to Achinstein, once this is done a model no longer claims to describe how X's in fact actually behave but only how they approximately behave. Nor does the model claim to set forth the laws by which X's are governed, only an approximation to this. That is, the assumptions of the model are recognized as making a weak literal claim with regard to the state of the world. This does not seem to be the case with theories, however. If one proposes a theory concerning X's, the impli-

implication seems to be made that X's are, in fact, governed by those principles expressed by the set of assumptions which constitute the theory. This is why puzzles arise with respect to the notion of alternative theories (surely one must be more correct than another!) which do not arise when one clearly restricts oneself to a discussion of alternative models.[5] For example, the billiard ball model of gases applies only to ideal gases; it does not attempt to describe accurately the behavior of actual gases. Thus, although the same set of assumptions may be involved, to call a particular set a "theory" is to make a considerably stronger claim to truth or accuracy of description than is involved when one says merely that this set of assumptions functions as a "model".

Secondly, with respect to characteristic b), theories need not attribute any inner structure to an object in order to explain various properties; it suffices merely to indicate relationships among the properties. Thirdly, with respect to d), theories need not be proposed within the context of more fundamental theories. Of these three major differences, the first will be most relevant to my discussion of Bruner.

Within the classroom, theoretical models are most often employed in the context of teaching the physical, biological and social sciences, areas in which the importance of analogical thinking as a means of understanding unfamiliar classes of

phenomena is recognized. Customarily, such models have been introduced in the later stages of primary and secondary education but if Bruner's emphasis on the teaching of basic theoretical concepts be carried through in terms of curriculum reform, the child could expect to encounter theoretical models at any stage in his intellectual development. And, as seen in the previous chapter, Bruner holds that, "...the most urgent need of all is to give our pupils the experience of what it is to use a theoretical model, with some sense of what is involved in being aware that one is trying out a theory."[6]

(3) Imaginary Models:

A third type of model which is occasionally employed is the imaginary model. Examples of such models are Poincaré's model of a Lobachevskian non-Euclidean world and Maxwell's model of the electromagnetic field. Three characteristics serve to describe imaginary models:

a) like theoretical models, imaginary models describe an object or system by a certain set of assumptions;

b) unlike theoretical models, imaginary models make no commitment with respect to the truth of or the plausibility of the assumptions made;

(This is an important characteristic because it means that in no way should the model be viewed as an approximation of what is actually the case.)

c) the point in employing imaginary models is to show what an object or system would be like if it were to satisfy certain conditions initially specified.

The value of imaginary models, as pointed out in c), might be to show that certain sets of assumptions are at least consistent whereas their consistency may previously have been in question.

In discussing the relationships among the three kinds of models, Achinstein summarizes by saying,

> ...when the scientist proposes a theoretical model of X, he wants to approximate to what X actually is by making assumptions about it. In an analogue model of X he wants to construct or describe some different item Y that bears certain analogies to X. In an imaginary model of X, he wants to consider what X could be like it if were to satisfy conditions he specified.[7]

This is not to say that the notion of various kinds of models is so clearly defined that one does not encounter problems in the application of the various terms. For example, problems arise concerning analogue models with respect to what the definite similarities are. Furthermore, it is often difficult to tell precisely what kind of model is being employed in a given context; thinkers who employ models are not themselves always clear on the degree of and kind of ontological commitment involved in their own use of a particular model. And often the line between theory and model is difficult to draw in practice. The status of a particular set of assumptions changes with the amount of further knowledge attained. This was the case with the Bohr theory of the atom now more commonly referred to as the Bohr model of the atom due to the inaccuracies of

Bohr's assumptions in relation to our present knowledge of the structure of the atom.

With these distinctions regarding kinds of models and an awareness of some of the difficulties involved in applying the various terms correctly, I shall now return to the passages drawn from Bruner's works. I shall examine them critically, one by one.

III

With respect to passage (1):

> I am inclined to think of mental development as involving the construction of a model of the world in the child's head, an internalized set of structures for representing the world around him. These structures are organized in terms of perfectly definite grammars or rules of their own, and in the course of development the structures change and the grammar that governs them also changes in certain systematic ways. (OK, 103)

It appears that, with respect to this passage, the most plausible candidate for the type of model involved is that of a theoretical model; representational models are ruled out on the grounds that the prototype, i.e. the world, is not known beforehand, a requirement which must be met whenever a representational model is involved. But to what extent can the term "model" in this passage refer to a theoretical model? Certainly it satisfies requirement a), that it consists of a set of assumptions. As seen in Chapter II, in the discussion of Bruner's Hypothesis Theory, Bruner is committed to the view that all one's cognitive structures are essentially clusters

of hypotheses, or assumptions about the nature of experience. Depending upon the specific structure involved, it may satisfy characteristics b) and c) But this is only a superficial mapping of the characteristics of various kinds of models to the passage involved.

It seems that there are certain difficulties with Bruner's use of the term in this passage which do not arise with respect to other people's use of the term when, for example, they refer to theoretical models such as the Bohr model of the atom or the liquid drop model of the atomic nucleus. First, in the examples just cited as well as in those mentioned earlier, theoretical models are proposed for very specific parts of classes of phenomena which make up our experience. It is questionable, therefore, whether it is equally as significant to speak of a model of the <u>world</u> in the same way that one can speak of models of the nucleus of the atom. What would a theoretical model of the <u>world</u> be like? I can describe the model of the nucleus of the atom in a limited number of statements. It does not appear obvious that I could do this with a "model of the world". It would seem that in order to describe such a model, one would need an infinite number of statements corresponding to an infinite number of phenomena to be described.[8] But if this world-model is, in fact, not attainable in principle since it involves an infinite number of statements, then intellectual development cannot consist

of the construction of such a model in the sense of the complete set of statements describing the phenomena under discussion.

Perhaps to claim that this is what Bruner has in mind is to interpret Bruner unfairly. He does go on to say, in passage (1), that this model is a set of structures which represent the world, structures which have a grammar, a "perfectly definite grammar" of their own. This is a second possible interpretation: that Bruner is claiming that these kinds of concatenated structures constituted "a" model of the world since each of the structures is a model of some aspect of experience (actual or possible) and their union would thereby be the model of the world for a given human subject. (I am here assuming that models would be the only suitable components of a world-model; one theory plus another theory does not equal a model of anything.) If this latter interpretation is what is involved here, how is one to distinguish between an individual's ideas about what the world is really like and his set of models of the world? I do not see that Bruner makes any distinction between these but clearly such a distinction is involved when we speak in terms of theoretical models. That is, it seems quite customary to inquire about an individual's ideas concerning the real nature of the physical world and to distinguish these from his set of theoretical models which enable him to understand certain

classes of phenomena in an acknowledged, simplified way. For example, few physicists think that the atomic nucleus is a kind of liquid drop although for certain purposes it might be helpful to view it in this way or along the lines in which one thinks of actual liquids and their formation. Considerably stronger truth claims are involved when one speaks of his ideas concerning the nature of the physical world than when one speaks of theoretical models.

Furthermore, many difficulties surround the notion of "definite grammars". Such questions as the following arise: what is this grammar? Is there more than one per structure? Does every structure have a grammar? Is there an optimal grammar? What is the force of saying "perfectly definite" grammar as opposed, presumably, to "indefinite grammar"? In response to the first question, one plausible interpretation that comes to mind is the notion of a logical calculus. But the assumption that children possess, unknown to themselves, a logical calculus at various stages in their intellectual development is rather dubious and requires considerably more reliable empirical confirmation than either Bruner or Piaget has offered in order to make this claim acceptable. With respect to the other question raised above, no clear, unambiguous answers are present in Bruner's work, particularly as I have shown, in Chapter III, that Bruner does not employ the term "grammar" in an entirely consistent fashion.

What Bruner seems to be driving at in this first passage is that individuals can be said to have certain theories about the world in the very wide sense of Kuhn and Feyerabend.[9] These theories may include ordinary beliefs about the existence of material objects, myths, religious beliefs as well as scientific theories in the strict sense. Such fundamental beliefs enable individuals to interpret their experience in the light of these beliefs and give meaning to their experience. If this is Bruner's intention, then he is using the term "model" in a very loose way as roughly synonymous with "theory" understood in this wide sense.[10] Whether such theories satisfy his requirement for having grammars is a question I shall not discuss in the context of this thesis although I tend to think that they would not. In short, the notion of model in passage (1) seems somewhat related to the notion of a theoretical model but it does not satisfy all the requirements of that class.

Turning now to passage (2):

> (2) ...the child whose behavior I was just describing had a <u>model</u> of quantities and order that are implicitly governed by all sorts of seemingly subtle mathematical principles, many of them acquired and some of them rather strikingly original. (<u>OK</u>, 103)

Now one finds that Bruner is using the term "model" in such a way that it seems to be synonymous with the meaning of the term "concept". But this is simply a misuse of the term under any interpretation of the three senses of "model" discussed

above. In the context of these three senses,one cannot have a model of a single idea such as quantity or order. One has a model of a system or class of phenomena but this consists of a set of assumptions which incorporate many ideas. One may have a three-dimension model of a train (a single object) but this is very different from having a model of quantity (a single abstract idea). If, by the use of the term "model" in passage (2), Bruner means to refer to the acquiring of a concept then he is misusing the term "model" in all the standard uses cited above. Perhaps Bruner means a set of axioms about order relations when he speaks of a model of order. This would be plausible except for the fact that this interpretation does not fit the notion of quantity. What would an axiom of quantity be? If Bruner is not using the term "model" as synonymous with "concept", then I am at a loss to interpret this passage. If this is what he is doing, then it is simply an incorrect use of the term "model".[11]

Suppose, however, that one grants this use of the term "model" to Bruner. What educational implications might this have? It is noteworthy that Bruner selects fairly abstract notions such as order or quantity in his illustrations. Utilizing models of mathematical relations is a far greater challenge for the teacher than providing models for concrete notions such as house, tree, organism, etc. Reading this passage leads one to a kind of ambiguity concerning the notion of model. Bruner appears to believe that somehow the child

acquires a model, in the theoretical sense, by manipulating physical models, models in the representational sense. But this is an enormous assumption to make, viz. that operating with physical embodiments of certain abstract ideas will lead to the emergence of a theoretical model constituted by "... subtle mathematical principles" on the part of the child,some of the propositions of which are viewed by Bruner as innate to the child's mind.[12] This same kind of ambiguity arises with respect to passage (6) and I shall discuss it further in that context.

Passage (3):

> Knowledge is a model we construct to give meaning and structure to regularities in experience. The organizing ideas of any body of knowledge are inventions for rendering experience economical and connected. We invent concepts such as force in physics,the bond in chemistry,motives in psychology, style in literature as means to the end of comprehension. (OK, 120)

When reading this passage, it is not clear whether Bruner now views the term "model" as restricted only to those concepts which organize one's experience (which concepts would that leave out?) or extended to all concepts in general. With respect to the former alternative, Bruner claims that we invent concepts such as force, bond, and motive. Well, in one sense this is true if Bruner means that we invent the word "force", etc. But this is trivially true. If, on the other hand, Bruner means that such terms do not carry with them referential claims about the existence of certain things in the world, then his claim stands in need of considerably more argument than he

gives it. As seen above, Bruner leans in the direction of the latter, a constructionist interpretation, but, as also seen in Chapter III, his remarks are not entirely consistent in this area.[13]

Passage (4):

> We know now...that experience is not to be had directly and neatly, but filtered through the programmed readiness of our senses. The program is constructed with our expectations and these are derived from our models or ideas about what exists and what follows what. (OK, 120)

This passage would seem to indicate that models are the same as one's "ideas of what exists and what follows what". Here again one finds the notion of models linked with the notion of ordinary ideas of what the world consists of and the regularities to be found in it. This is, as seen above, a very loose employment of the term "model". But when one examines passage (4) more closely, one finds a peculiar move on Bruner's part, a move which seriously calls into question any plausible interpretation of his use of the term "model" in passage (1) and, as shall be seen, in passage (5) as well as his use in the presently considered passage.

In passage (4), Bruner informs us that we are, somehow, never able to step outside our model of the world to see what the world is "really like" because all the experience, or input, that we derive from experience has been filtered through our conceptual network, our set of structures which in turn have

somehow produced "programmed readiness of our senses."[14] Moreover, Bruner moves from the claim that our theories do, in part, influence our perceptual experience to the claim that, therefore, "experience is not to be had directly". But this seems to be an obvious instance of Bruner's committing a fallacy of black-and-white thinking. And this overestimation will be costly to Bruner for I shall try to show that such epistemological views make it inappropriate for Bruner to employ the term "model" at all.

The argument is this: When one speaks of models, in <u>any</u> sense whatever, the implication is present that one is able in some way or other to compare the model with either the prototype or the thing of which something is said to be a model. (I am here assuming that Bruner is not interested in imaginary models which make no claim to be related to the actual world.) It is this possibility of <u>comparison</u>, in principle, which allows one to choose among models those which are most accurate, correct and useful, i.e. to choose between good and bad models. But if one is to take what Bruner says in (4) seriously, then this possibility of comparison seems to be ruled out since one has no means of access through experience to any data which is not, in important ways, already formed in accord with the structures of the models he employs. In short, viewing passage (4) as a unified statement of Bruner's views, he should jettison the word "model" as

incorrectly used since his explicit epistemological views rule out the use of this term in <u>any</u> sense whatever. Whether these epistemological views are correct seems to be an important but independent question and is not a problem for the present thesis.

I made earlier reference to passage (5):

> Growth depends upon internalizing events into a 'storage system' [sic] that corresponds to the environment. It is this system that makes possible the child's increasing ability to go beyond the information encountered on a single occasion. He does this by making predictions and extrapolations from his stored <u>model</u> of the world. (<u>TI</u>, 5)

Apart from the curious use of quotation marks concerning the phrase "storage system", Bruner now seems to be equating a model with systematic knowledge of the world, i.e. theory in a stricter sense than in passage (1). But, again, as seen above, one cannot identify model and theory. If one claims that he has a systematic set of beliefs about the world which corresponds to his environment, he is making claims that go beyond the claims made for any theoretical model. Such claims apply more directly to theories. In fact, making such claims is one of the functions of theories, not models, and theories and models make widely varying truth claims. Furthermore, what Bruner intends here by his emphasis on the word "correspond" and the phrase "information encountered" appears to be inconsistent with his views expressed in passage (4) where the possibilities of checking the correspondence and of having

system-free experience which provides new information seem to be ruled out.

Passage (6):

> The achievement of more comprehensive insight requires, we think, the building of a mediating representational structure that transcends such immediate imagery, that renders a sequence of acts and images unitary and simultaneous. The children always began by constructing an embodiment of some concept, building a concrete model for purposes of operational definition. (TI, 65)

This passage seems to make a clear break with any of the above uses of the term "model". In this context, the term "model" seems to refer to representational models in a very straightforward way. This clear use of the term is, however, preceded by a very packed sentence. When one unravels that sentence, which employs the notion of representational structures (a notion seen to be synonymous with the notion of a model in some of the above passages) it is clear that Bruner is not making a very striking claim. That is, he appears to be saying simply that if you wish to think more comprehensively, then you should utilize comprehensive concepts, i.e. think more comprehensively -- a not very exciting claim and one which looks suspiciously like a tautology. This statement is, however, of great significance for the discussion of this chapter. In it one can see Bruner's most explicit equivocation with respect to the notion of model. The first part of the passage appears to refer the term "model" to model in the theoretical sense, a "mediating representational structure";

the latter part of the passage clearly introduces a different sense of the term "model", model in the representational sense.

In other words, in these passages, Bruner travels almost the entire range of possible uses of the term employing it sometimes to stand for theoretical models in a strict sense, sometimes for theory in a very broad sense, sometimes for ideas or concepts (an incorrect use), and now to stand for the notion of representational structures of an ordinary, tinkertoy variety. If Bruner starts with the notion of model in the representational sense as his paradigm, as it appears in the second part of passage (6), then it is reasonable to expect Bruner to advise teachers in classrooms to present the pupils with many representational models with the underlying idea being that this experience will then produce an awareness of the basic structure of the field under study. This awareness results in a kind of isomorphic mapping of the structure of the subject matter to the student's brains, the structure thereby becoming internalized. Presumably, such structures, once joined together, will then produce a model of the world. Such a view results naturally from the implicit sliding from one sense of "model" to another without explicit acknowledgement of important and fundamental differences among the various senses.

IV

To summarize this chapter then, one sees that Bruner begins with the notion of model understood in a very wide sense as synonymous with theory, the latter also understood in a very broad sense. This use shifts in a very subtle ways into a more specific and precise use of "model" where it appears to be identical with a theoretical model in the sense of a system. This sense eventually evolves to the sense of model in the straightforward sense of representational model. Throughout all these shifts, Bruner seems to be making very subtle and complex equivocations on the term "model", equivocations of which the reader is largely unaware. One might be very willing to go along with Bruner's initial use of the term, but it is not so clear that one must thereby be committed to all of Bruner's uses of the term especially when far-reaching educational implications may rest on this foundation of equivocations.

Can Bruner's views be reformulated in such a way as to avoid such dangerous and tempting equivocations? I tend to think not unless he is willing to overhaul completely his entire theory about the nature of human learning and the nature of subject matters per se. As I have stated at the beginning of this chapter, the term "model" is linked very closely with other key notions in Bruner's theory, particularly the notions of cognitive structure and structure of a discipline. In order to make

explicit all the subtle differences of meaning involved in passage (1-6), I think that Bruner would have to alter many of his other basic concepts in very complex ways which would significantly change his entire educational program. Such conceptual purging will, however, not be carried out in the context of this thesis.

Chapter V:

CONCLUSION

In this thesis, then, I have first set up a general framework in terms of which I argued that Bruner should be classified as a cognitive developmental psychologist. I then proceeded to distill Bruner's epistemological views from his more general position concerning the development of human knowledge. I then subjected two of the key elements of that epistemological system to a philosophical examination: a) the public form of knowledge as it is codified in terms of learned disciplines, in literate societies; b) the private correlate which is present in the minds of human cognizers, viz. the model or set of cognitive structures which enables each human being to cope with his experience. As much of that philosophical examination consisted of very speficic criticisms directed at specific remarks of Bruner's, I wish, in this conclusion, to carry out two main intentions: first, to return to and attempt to answer the five epistemological questions which initiated this study and, second, to comment on the cumulative effects of those criticisms presented in Chapters III and IV.

The five questions, as set forth in Chapter I, are:

(1) What is knowledge?
(2) What knowledge is most reliable or important?
(3) How does knowledge arise?
(4) How should the search for knowledge be conducted?

(5) How is knowledge best taught?

I shall try, in very sketchy form, to give Bruner's answers to these questions as these answers emerge from his writings.

(1) What is Knowledge?

Knowledge, for Bruner, is essentially a constructed tool or set of sophisticated abilities designed to simplify and extend man's power over his experience. Knowledge is not merely something inert, passive or stored. For Bruner, it is essentially a pragmatic device which human beings use to deal more comprehensively with their experience. This knowledge is present in at least two different forms: a public form in which the corporate knowledge in a given culture is codified in a visible, publicly accessible form, and, secondly, in a private form in which each human cognizer has his own, idiosyncratic set of capacities, most or all of which are derived from the public form.

(2) What Knowledge is most reliable or important?

For Bruner, there is no specific kind of knowledge which is, prima facie, more important than any other. Rather, whatever works (in the sense of being able to simplify and predict experience) is thereby important.

Concerning the issue of reliability, I have stressed that Bruner is clearly committed to a very hybrid theory of truth. As seen in Chapter II, a particular belief can be validated or judged reliable in any or all of four possible ways:

(1) direct test by correspondence; (2) consistency with other hypotheses; (3) affective congruence (feeling of subjective certainty); and, (4) reference to authoritative statements. Once a particular belief satisfied these criteria, it is still open to rejection in that it may fail to do any or all of the following things:

(1) allow a person to generate further beliefs from it;

(2) reduce environmental complexity;

(3) order and relate events;

(4) establish links with other believed hypotheses.

Hence, for Bruner, that knowledge is most important which works and that knowledge which works is, with all probability, that which satisfies those above-mentioned criteria for truth and justification.

(3) How does Knowledge arise?

For Bruner, knowledge arises primarily from two sources: that which is innate such as the ability to learn to speak a language and correlative formal concepts such as causation, modification, continuity of space and time, etc. and, second, from those hypotheses which the human subject produces when confronted with environmental complexity. In terms of its cultural source, knowledge arises, says Bruner, when the growing members of that culture adopt the fundamental ways of thinking which predominate in the culture. Underlying these sources is the basic desire, says Bruner, for man to control

and have power over his experience.

(4) How should the search for Knowledge be conducted?

The search for knowledge, says Bruner, should be conducted with reference to and in accordance with those personal and cultural sets of cognitive structures which have been found to work in the past, with an awareness that one can never, in any complete way, escape the ways of thinking which receive organized form within those structures. As Bruner puts it, experience is never model-free.

(5) How is Knowledge best taught?

Knowledge is best taught, says Bruner, when it is taught as a mode (or modes) of thinking which is essentially a powerful tool which each individual knower puts to his own use. Such an understanding is gained, argues Bruner, if one teaches disciplines in such a way that the learner participates in them as powerful ways of thinking, a participation most likely achieved if the student is encouraged to discover in the ways proper to each discipline. Knowledge has been best taught, then, when the knowledge the individual learner has corresponds to that mode of knowledge which has become codified in the culture and extended by the expert practitioners in that area.

Hence, one sees that Bruner, as psychophilosopher, has supplied answers to all the above questions concerning the nature and development of human knowledge.

I now wish to comment, somewhat speculatively, on the force of my criticisms concerning Bruner's responses in these areas.

(1) Concerning the first response, I have not seriously challenged the constructionist, pragmatic account of knowledge presented by Bruner other than to point out a tendency on Bruner's part to interpret "construct" in a strong, existential sense. I have, however, attempted to clarify the two <u>forms</u> of knowledge and have found the two basic notions, structure of a discipline and model of the world, seriously wanting in this respect. I have argued that <u>both</u> of these notions are highly equivocal in Bruner's works and fail to provide a clear program of action in terms of the pedagogical implementation of Bruner's basic ideas.

(2) Concerning Bruner's response to this question, I have had little to say because the problems of a theory of truth and a theory of justification are too broad to be covered in the space of this thesis.

(3) Concerning Bruner's answer to this issue, I do not challenge here the innateness of certain human properties. However, I do question Bruner's <u>argument</u> in favor of specific innate categories. Insofar as my objections are relevant, Bruner's theory is weakened, at least from the point of lacking support.

(4) Concerning the issue of how one ought to search for knowledge, I have questioned the coherency of the notion "model of the world" and, failing to find a coherent interpretation, I am at a loss as to decide whether or not we can step outside of our "model of the world" and, secondly, whether one can significantly speak, as Bruner does, about "direct tests of correspondence". I tend to think not, at least with respect to this latter issue.

(5) Finally, in dealing with this last issue, I argue in Chapters III and IV, that if one reads Bruner and his attempts to answer the question of "How knowledge is best taught" one cannot derive a consistent program of action either for curriculum developers or teachers in the classroom, primarily because Bruner is not clear about what should be taught (the focus of my discussion in Chapter III) and, correlatively, what one is to look for in terms of what is developing within individual students (the focus of my discussion in Chapter IV). Once it is granted that there is a fundamental lack of clarity here, Bruner's entire set of educational proposals begins to look highly suspicious.

To conclude, then, if my arguments in Chapters III and IV are correct, then it appears to me that there is a basic flaw in Bruner's epistemology. Although I have not questioned significantly Bruner's views of the knower and the knowing process, I have argued that Bruner is not very clear about

what it is that is actually known. And, indeed, if one is not clear about how to recognize that and when one knows something, then it is of little avail to have views about the knower and the knowing process. In short, if Bruner does not or cannot arrive at a clearer understanding about what is known, then his epistemological views are, at best, radically deficient and, at worst, useless.

FOOTNOTES

CHAPTER I:

[1]Israel Scheffler, Conditions of Knowledge. Chicago: Scott, Foresman and Co., 1965, p. 5.

[2]Bärbel Inhelder, "Some Aspects of Piaget's Genetic Approach to Cognition" in Wm. Kessen and Clementina Kuhlman, edits., Thought in the Young Child, Monograph of the Society for Research in Child Development. 27, No. 2 (1962), p. 19.

[3]William Kessen, "Questions for a Theory of Cognitive Development", in H. W. Stevenson, edit., Concepts of Development, Monograph of the Society for Research in Child Development. 31, No. 3 (1966), pp. 55-70.

[4]Kessen, Ibid., p. 58.

[5]Kessen, Ibid., p. 62.

[6]W. M. O'Neil, "Basic Issues in Perceptual Theory" in John Eliot, edit., Human Development and Cognitive Processes. New York: Holt, Rinehart and Winston, Inc., 1970.

[7]Taken from Hans G. Furth, "Piaget's Theory of Knowledge: The Nature of Representation and Interiorization" in Eliot, edit., Ibid., p. 287.

[8]John Anderson, "Dynamics of Development: System in Process" in Eliot, edit., Ibid., p. 48.

[9]T.C. Schneirla, "The Concept of Development in Comparative Psychology" in Eliot, edit., Ibid., p. 56.

[10]Heinz Werner, "The Concept of Development from a Comparative and Organismic Point of View" in Dale B. Harris, edit. The Concept of Development. Minneapolis, Minn.: University of Minnesota Press, 1957, p. 126.

[11]L. Kohlberg and R. Kramer, "Continuities and Discontinuities in Childhood and Adult Moral Development." Human Development. 12 (1969), pp. 93-120.

[12]Ibid., p. 98.

[13]Conceptual difficulties arise in this area because any change, by definition, involves newness and sometimes whether or not some alteration involves newness in the requisite sense may be a matter for stipulation.

[14]Ernest Nagel, "Determinism and Development" in D. Harris, edit. op cit., pp. 15-24.

[15]Ibid., p. 16.

[16]Ernest Nagel, Structure of Science. New York: Harcourt, Brace and World, 1961. p. 76.

[17]William Kessen, "'Stage' and 'Structure' in the Study of Children," in Kessen, Kuhlman, edits., op cit., pp. 66-71.

[18]Ibid., p. 71.

[19]Inhelder, in Kessen, Kuhlman, edits., op cit., p. 23.

[20]Kohlberg, Kramer, op cit., p. 99.

[21]R. Descartes, Meditations: On First Philosophy, trans. Laurence Lafleur. New York: Bobbs-Merrill, 1960, 2nd edition, p. 27.

[22]Ulric Neisser, Cognitive Psychology. New York: Appleton-Century Crofts, 1967, p. 4.

[23]Ibid., p. 5. It is to be noted here that this passage is a conspicuous illustration of an argument which commits the fallacy of begging the question.

[24]Ibid., p. 140.

[25]Sam Glucksberg, "Thinking: A Phylogenetic Perspective" in Eliot, edit., op cit., p. 460.

[26]Kessen, Stevenson, edit., op cit., p. 61.

[27]See, for example, Joachim Wohlwill, "From Perception to Inference: A Dimension of Cognitive Development," in Kessen, Kuhlman, edits., op cit., p. 87.

[28]G. Thomas Rowland and J. Carson McGuire, The Mind of Man: Some Views and a Theory of Cognitive Development. Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1971,pp. 4-5.

[29]Neisser, op cit., p. 287.

[30]Neisser, op cit., pp. 289-292.

[31]Neisser, op cit., p. 3.

[32]Daniel Berlyne, "Discussion: The Delimitations of Cognitive Development: in Stevenson, edit., op cit., pp. 71-81. See also, _____, Structure and Direction in Thinking. New York: John Wiley and Sons, 1965, pp. 126-137.

[33]Ibid., in Stevenson, edit., p. 75.

[34]Ibid., p. 75.

CHAPTER II:

[1]Jerome S. Bruner, "The Psychology of Pedagogy," in Anita Gil, edit., The Relevance of Education. New York: W. W. Norton and Co., 1971, pp. 126-127.

[2]F. H. Allport, Theories of Perception and the Concept of Structure. New York: John Wiley and Sons, 1961.

[3]Cf. Jerome S. Bruner and Leo Postman, "On the Perception of Incongruity: A Paradigm." Journal of Personality, 19 (1949), pp. 206-223; _____, "Perception, Cognition and Behavior," Ibid., 18 (1949), pp. 14-31.

[4]F. H. Allport, op cit., pp. 376-377.

[5]Jerome S. Bruner, Jacqueline Goodnow and G. A. Austin, A Study of Thinking. New York: John Wiley and Sons, 1956, p. 56.

[6]Ibid., p. 54.

[7]Jerome S. Bruner, "The Perfectibility of Intellect" in Relevance of Education, op cit., p. 6.

[8]As mentioned in Chapter I, Bruner's views concerning the impossibility of model-free existence raise this problem as well as his work on the process of perceiving. In Chapter IV, I argue that Bruner cannot provide an adequate explanation of error.

[9]Joachim Wohlwill, "From Perception to Inference: a Dimension of Cognitive Development," in William Kessen and Clementina Kuhlman, edits., Thought in the Young Child, Monograph of the Society for Research in Child Development. 27, No. 2 (1962), p. 89.

[10]Jerome S. Bruner, "On Perceptual Readiness," Psychological Review. 64 (1957), pp. 123 ff.

[11]Jerome S. Bruner, Processes of Cognitive Growth: Infancy. Worcester, Mass.: Clark University Press, 1968, p. 68.

[12]Jerome S. Bruner, "The Psychobiology of Pedagogy," Relevance of Education, op cit., pp. 125-126.

[13]See, for example, Jerome Bruner, Rose Olver, Patricia Greenfield and others. Studies in Cognitive Growth. New York: John Wiley and Sons, Inc., 1966, p. 5.

[14]Bruner, Goodnow, and Austin, Thinking, op cit., p. 50.

[15]From Ulric Neisser, "Cultural and Cognitive Discontinuity" in the Anthropological Society of Washington, Anthropology and Human Behavior. Washington, D.C.: Gaus, pp. 54-71. Quoted by Bruner in Studies in Cognitive Growth, op cit., p.64.

[16]Bruner, "Perfectibility of Intellect," Relevance of Education, op cit., p. 12.

[17]Jerome S. Bruner, On Knowing: Essays for the Left Hand. Cambridge, Mass.: Harvard University Press, 1964.

[18]Jerome S. Bruner, "The Course of Cognitive Growth." The American Psychologist. 19 (1964), pp. 1-15.

[19]Cf. for example, Jerome S. Bruner, Toward a Theory of Instruction. New York: W.W. Norton and Co., Inc., 1966.

[20]This particular notion of mental imagery appears to me to be the weakest link in Bruner's developmental theory. Bruner's remarks concerning it are always very brief and no classification is offered concerning the precise nature of an image.

[21]Bruner, Toward a Theory..., op cit., p. 11.

[22]Bruner, "Course of Cognitive Growth," op cit., p. 4.

[23]Cf. Alexander Luria, The Role of Speech in the Regulation of Normal and Abnormal Behavior. New York: Liveright Publishing Corporation, 1961.; Lev Vygotsky, Thought and Language. Cambridge, Mass.: MIT Press, 1962.

[24]John Anderson, "Dynamics of Development: System in Process," in John Eliot, edit., Human Development and Cognitive Processes. New York: Holt, Rinehart and Winston, Inc., p. 53.

[25]Ibid., p. 53.

[26]Bruner, et al, Studies in Cognitive Growth, op cit., p. 47.

[27]Ibid., p. 15.

[28]Ibid., p. 43.

[29]The extent to which Bruner adopts Chomsky's theoretical outlook is discussed in detail in Chapter III.

[30]Bruner, "Course of Cognitive Growth", op cit., p. 3.

[31]Bruner, Processes of Cognitive Growth: Infancy, op cit.

[32]Ibid., p. 45.

[33]Ibid., p. 45.

[34]Ibid., pp. 35-53.

[35]Ibid., p. 47.

[36]Bruner, "Course of Cognitive Growth", op cit., p. 7.

[37]Ibid., pp. 10 ff.

[38]Jerome S. Bruner, "A Psychologist's Viewpoint: Review of The Growth of Logical Thinking by B. Inhelder and J. Piaget." British Journal of Psychology. 50 (1959), pp. 363-70.

[39]Bruner often stresses that in many non-technical societies, sophisticated symbolic functioning is not necessary and that such functioning does not appear to occur in the cognitive development of members of such societies. See, e.g. Bruner, Toward a Theory..., op cit.

[40]Ibid., p. 21.

[41]Ibid., p. 21.

[42]Ibid., p. 40.

[43]Ibid., p. 49.

[44]Bruner, On Knowing, op cit., p. 120.

[45]Jerome S. Bruner. "The Process of Education Revisited", Phi Delta Kappa. 53 (1971), pp. 18-21.

[46]Bruner, Toward a Theory..., op cit., p. 154.

[47]See, for example, the material in the book, Lee Shulman and Evan Keislar, edits., Learning by Discovery: A Critical Approach. Chicago: Rand,McNally and Co., 1966.

[48]Bruner, On Knowing, op cit., pp. 82-83.

[49]Bruner, Toward a Theory..., op cit., p. 96.

[50]In the article, "The Process of Education Revisited", op cit., Bruner appears to have mellowed somewhat on this point.

[51]Bruner, On Knowing, op cit., p. 87.

[52]Jerome S. Bruner, "The Will to Learn," Commentary. 41 (1966), pp. 41-46.

[53]Bruner, On Knowing, op cit., pp. 95-96.

CHAPTER III:

[1]David P. Ausabel. "Some Psychological Aspects of the Structure of Knowledge" in Stanley Elam, edit. Education and the Structure of Knowledge. Chicago,Illinois: Rand McNally and Co., 1964., p. 223.

[2]Jerome S. Bruner. On Knowing: Essays for the Left Hand. Cambridge, Mass.: Harvard University Press, 1962, p. 1.

[3]Ibid., pp. 77-78.

[4]Ibid., pp. 129-130.

[5]Jerome S. Bruner. "The Course of Cognitive Growth," The American Psychologist. 19 (January, 1964), p. 13.

[6]Jerome S. Bruner, Rose Olver, Patricia Greenfield, et al. Studies in Cognitive Growth. New York: John WIley and Co., 1966, p. 319.

[7]Ibid., p. 320.

[8]Jerome S. Bruner. Toward a Theory of Instruction. New York: W.W. Norton and Co., Inc., 1966, p. 2.

[9]Jerome S. Bruner, "The Perfectibility of Intellect" in Anita Gil, edit. The Relevance of Education. New York: W.W. Norton and Co., 1971, pp. 5-6.

[10]Bruner, "The Course of Cognitive Growth", op cit., p. 13.

[11]Ibid., p. 13.

[12]Jerome S. Bruner, "Toward a Disciplined Intuition" in Anita Gil, edit. The Relevance of Education, op cit., p. 94.

[13]Jerome S. Bruner, "Some Elements of Discovery" in Lee Shulman, Evan Keislar, edits., Learning by Discovery: A Critical Approach. Chicago, Ill.: Rand, McNally and Co., 1966, p. 109.

[14]Bruner, "Toward a Disciplined Intuition" in Relevance of Education, op cit., p. 94.

[15]Ibid., p. 94.

[16]Bruner, "The Course of Cognitive Growth", op cit., p.2.

[17]Cf. for example, Bruner, "The Perfectibility of Intellect", Relevance of Education, op cit., p. 8; Studies in Cognitive Growth, op cit., p. 30.

[18]Noam Chomsky, Language and Mind. New York: Harcourt, Brace and World, Inc., 1968, pp. 68-69.

[19]Jerome S. Bruner, "The Control of Human Behavior", in On Knowing, op cit., p. 137.

[20]Bruner, On Knowing, op cit., p. 117.

[21]Bruner, Toward a Theory of Instruction, op cit., p. 107.

[22]Ibid., pp. 108-109.

[23]Much of Bruner's empirical work in the area of perception has dealt with, for example, the influence of predisposing a subject's perceiving by mentioning a single, key interpretive word prior to the experience of seeing a somewhat indeterminate stimulus. Such research, in itself, does not warrant the inference that language affects "forms of awareness" in a very broad sense, merely that in very controlled circumstances, verbal cues affect specific responses on the part of a subject. See, for example, Jerome S. Bruner and Leo Postman, "On the Perception of Incongruity: A Paradigm" in J. S. Bruner, edit. Perception and Personality: A Symposium. New York: Greenwood Press, Publishers, 1968. pp. 207-223; Jerome S. Bruner and Leo Postman, "Perception, Cognition, and Behavior", Ibid., pp. 14-31.

[24]Jerry A. Fodor and Jerrold J. Katz, "The Structure of a Semantic Theory" in Fodor and Katz, edits. The Structure of Language: Readings in the Philosophy of Language. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964, p. 483.

[25]All terminology here derives primarily from the writings of Chomsky. In particular, see Noam Chomsky, "Current Issues in Linguistic Theory" in Fodor, Katz, edits., Ibid., pp. 50-118, passim.

[26]Noam Chomsky, "A Transformational Approach to Syntax" in Fodor, Katz, edits., Ibid., pp. 211-245.

[27]For example: Passive, Interrogative, Negation, Contraction, Inversion, Auxiliary, Nominalization, Adjectivalization, Self.

[28]Noam Chomsky, Syntactic Structures. The Hague: Mouton and Co., 1966, p. 15.

[29]Ibid., p. 15.

[30]Bruner, Toward a Theory of Instruction, op cit., p. 11.

[31]Bruner, et al, Studies in Cognitive Growth, op cit., p. 33.

[32]Ibid., p. 36.

[33]Ibid., p. 37.

[34]Ibid., p. 33.

[35]Ibid., p. 43.

[36]Ibid., p. 47.

[37]Ibid., p. 47.

[38]Ibid., p. 319.

[39]Bruner, "Toward a Disciplined Intuition" in Relevance of Education, op cit., p. 94.

[40]Ibid., p. 94.

[41]Bruner, "Some Elements of Discovery" in Learning by Discovery, op cit., p. 102.

[42]Bruner, "After John Dewey, What?" in On Knowing, op cit., p. 120.

[43]William Kessen, "'Stage' and 'Structure' in the Study of Children" in William Kessen and Clementina Kuhlman, edits., Thought in the Young Child: Monograph of the Society for Research in Child Development. 27, No. 2 (1962), p. 81.

[44]Bruner, "Patterns of Growth" in Toward a Theory of Instruction, op cit., p. 21.

[45]I am grateful to Lukinsky for providing this taxonomy although he refers to what I have called 'the content sense' as 'substantive structure' and his discussion ranges over all those writers who have dealt with the notion 'structure of a discipline' in educational theory. I am here restricting these terms specifically to Bruner in whose work all three senses are exemplified. See Joseph Lukinsky, "'Structure' in Educational Theory, Part I", Educational Philosophy and Theory. II (1970), pp. 15-31.

[46]Jerome S. Bruner. The Process of Education. Cambridge, Mass.: Harvard University Press, 1960, p. 3.

[47]Ibid., p. 82.

[48]Ibid., p. 31.

[49]Ibid., p. 11.

[50]Jerome S. Bruner, "The Psychobiology of Pedagogy" in Relevance of Education, op cit., pp. 122-123.

[51]Bruner, Toward a Theory of Instruction, op cit., p. 70.

[52]Ibid., p. 51.

[53]Ibid., p. 48.

[54]Ibid., p. 45.

[55]Ibid., p. 96.

[56]Bruner, "The Perfectibility of Intellect" in Relevance of Education, op cit., p. 15.

[57]Bruner, On Knowing, op cit., p. 106.

[58]Ibid., p. 62.

[59]Bruner, Toward a Theory of Instruction, op cit., p. 72.

[60]Ibid., p. 154.

[61]Bruner, On Knowing, op cit., p. 116.

[62]Bruner, "Some Elements of Discovery" in Learning by Discovery, op cit., p. 104.

[63]Bruner, The Process of Education, op cit., p. 18.

[64]Bruner, The Relevance of Education, op cit., p. 16.

[65]Bruner, Process of Education, op cit., p. 20.

[66]Ibid., p. 28.

[67]Bruner, "Toward a Disciplined Intuition" in Relevance of Education, op cit., p. 95.

[68]Ibid., p. 95.

[69]Bruner, Toward a Theory of Instruction, op cit., p. 74.

[70]Ibid., p. 76.

[71]Bruner, "Toward a Disciplined Intuition" in Relevance of Education, op cit., p. 94.

[72]Cf., On Knowing, op cit., p. 3 and "Some Elements of Discovery" in Learning by Discovery, op cit., p. 102.

[73]Cf., Towards a Theory of Instruction, op cit., p. 70 and Process of Education, op cit., pp. 11-12.

[74]This same criticism could be extended to the methodological sense as well. Concerning the methodological sense, it appears to me that, for example, practicing geometers may not follow any prescribed set of procedures or heuristic patterns, that the deductive pattern of mathematical thinking is probably a very limited picture of what actually takes place.

[75]Jerome S. Bruner, "Art as a Mode of Knowing" in On Knowing, op cit., p. 72.

[76]It should be mentioned here that Bruner has a rather peculiar view of the notion of logical necessity. In Toward a Theory of Instruction, he says,

> Let me focus on the idea of logical necessity. It seems reasonable to suppose that the idea of logical necessity depends upon a process of dealing not with experience directly but...with the nature of propositions themselves..... The notion of logical necessity is somewhere in between what an unself-conscious child does and what a mathematician does.

Toward a Theory of Instruction, op cit., p. 20.

[77]I am omitting a discussion of the third sense of "generativity", discussed above as "less strict implications" because I simply do not comprehend what Bruner means here by this notion. Certainly, the one illustration he offers provides little or no illumination and I indicated my puzzlement in the context of that discussion.

[78]Bruner, Process of Education, op cit., p. 7.

[79]Ibid., p. 18.

[80]One would imagine that Bruner would not be particularly delighted by a remark made by Lukinsky, op cit., to the effect that concepts in small particle physics change every four years, on the average.

[81]Bruner, Toward a Theory of Instruction, op cit., p. 48.

[82]The notion of an analog model will be discussed in greater detail in Chapter IV.

[83]Bruner, On Knowing, op cit., pp. 61-62.

[84]Bruner, "Elements of Discovery" in Learning by Discovery, op cit., p. 104.

[85]Bruner, On Knowing, op cit., p. 121.

[86]Bruner, Process of Education, op cit., p. 20.

[87]Bruner, "Toward a Disciplined Intuition", Relevance of Education, op cit., p. 94.

[88]Bruner, Toward a Theory of Instruction, op cit., p. 76.

CHAPTER IV:

[1]Jerome S. Bruner, On Knowing: Essays for the Left Hand. Cambridge, Mass.: Harvard University Press, 1964; Jerome S. Bruner, Toward a Theory of Instruction. New York: W. W. Norton and Co., 1966.

[2]Cf. Peter Achinstein, Concepts of Science. Baltimore, Maryland: Johns Hopkins University Press, 1968; Max Black, Models and Metaphors. Ithaca, New York: Cornell University Press, 1962; May Brodbeck, "Models, Meaning, and Theories", Readings in the Philosophy of the Social Sciences. New York: Macmillan and Co., 1968, pp. 579-601; Mary Hesse, Models and Analogies in Science, Notre Dame, Indiana: University of Notre Dame Press, 1966. These thinkers are substantially in accord with Achinstein's taxonomy of models and his claim that theories and models have varying truth claims.

Philosophers of science are being utilized in this context for two reasons: (1) they are the only philosophers who have dealt, in explicit fashion, with the notion of model and have tried to give a comprehensive taxonomy of this notion; (2) Bruner seems implicitly to think of most or all subjects of study as patterned after the study of the physical sciences. Where these accounts are seen to be narrower than might be desired from the point of view of educational theory, this will be noted in the text.

[3]The account which follows is substantially that of Peter Achinstein, op cit., pp. 223-225.

[4]Lest it be thought that, for example, the billiard ball model of a gas is a representational model, the following features must be kept in mind. Concerning the kinetic theory of gases, there are at least four different models of gases which are operative: 1) the model which deals with gas molecules as if they were rigid elastic spheres; 2) the model which regards gas molecules as weakly attracting rigid elastic spheres; 3) that model which regards gas molecules as point centers of inverse power repulsion; 4) combinations of inverse power attraction and repulsion. The billiard ball model of gases is that model referred to by the first description, and the assumptions made in this model apply to ideal billiard balls, not to actual ones. Hence, it is clear that the billiard ball model of a gas, at least in this context, refers to a theoretical model.

[5]Here it should be mentioned that Brodbeck, op cit., does discuss the claim that "theory" and "model" are sometimes used synonymously, especially by some social scientists. However, she is not particularly happy with this practice and suggests that it can be very misleading.

[6]Bruner, Toward a Theory of Instruction, op cit., p. 96.

[7]Achinstein, op cit., p. 222.

[8]This objection is very similar to the criticism directed against phenomenalists who are unable to give a complete analysis of any perceptual experience, an objection which has proved quite damaging to the phenomenalist account of perceptual judgments.

[9]Paul Feyerabend, "Explanation, Reduction, and Empiricism." Minnesota Studies in the Philosophy of Science. edit. H. Feigl, G. Maxwell, (1962), pp. 28-97. Thomas Kuhn, The Structure of Scientific Revolutions. Chicago, Ill.: University of Chicago Press, 1962.

[10]Black, op cit., also introduces the notion of a model of the world in the sense of a root metaphor. But this is clearly acknowledged by Black to be a very derivative sense of the term "model".

[11]It might be argued that Bruner is referring to the child's set of concepts concerning, e.g. order, but this is a rather curious way of speaking. Ordinarily, one refers to the child's mastery of "the conept of order in mathematics" not to a set of concepts concerning order. Obviously many other concepts are related to the concept of order but this is not what Bruner is saying.

[12]Bruner seems to tend more and more toward a kind of innatist view of learning. In one of his more recent essays, "Some Elements of Discovery" in Lee Shulman and Evan Keislar, edits., Learning by Discovery: A Critical Appraisal, Chicago, Illinois: Rand, McNally and Co., 1966., Bruner says, "Discovery teaching generally involves not so much the process of leading students to discover what is 'out there', but, rather their discovering what is in their own heads." p. 105.

[13]Furthermore, this entire constructionist view of how we think seems to be grossly at odds if not entirely inconsistent with Bruner's repeated emphasis on the discovery of equivalences in the world, an essential element in the process of concept attainment, and the recognition of complex environmental regularities. Bruner's position on this issue has become somewhat blurred with his recent pronouncements in the essay, "Some Elements of Discovery", op cit. Cf. Toward a Theory of Instruction, op cit., p. 2 for examples of Bruner's earlier remarks.

[14]Bruner's remarks here are again very Kantian with the one exception that Kant maintains in the Critique of Pure Reason that the senses, forms of intuition, had a structure of their own independent of the working of the concepts.

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