CRITERIA FOR SYSTEMS MODELS AND THEIR APPLICATION TO A SOCIOLOGICAL THEORY OF ORGANIZATIONS

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY

Gwen Andrew

1961

This is to certify that the

thesis entitled

Criteria For Systems Models and Their Application to a Sociological Theory of Organizations

presented by

Gwen Andrew

has been accepted towards fulfillment of the requirements for

Ph.D. degree in Sociology

Donald W. Olmsted
Major professor

Date May 5, 1961

O-169

ABSTRACT

CRITERIA FOR SYSTEMS MODELS AND THEIR APPLICATION TO A SOCIOLOGICAL THEORY OF ORGANIZATIONS

by Gwen Andrew

The problem of the thesis consisted first, of an exploration of the characteristics of models in general and of their use as heuristic devices for the explication of substantive theory. Second, the criteria of systems models were specified. Third, the results of the systems analysis were applied to a sociological theory couched in a system framework.

The theory used was Alvin Gouldner's analysis of functional systems which was construed as a theory of bureaucratic organizations and divergences found between the theory and the interpretations suggested by the analytic systems model developed in the thesis were explored in terms of alternative formulations.

A model was said to be informative and productive when in a precise, formally specifiable relationship to the theory for which it stands as a model. When this condition of isomorphism is met the derivation of new hypotheses or the correction of faulty hypotheses is enabled. In this thesis the analytic model is used, i.e., a model without substantive content. Its import is that, through it, the relationships of logical consequence for all relevant kinds of system theories are exposed to analysis.

A system was taken to be a conventionally selected set of variables which putatively interact. Empirical test is required to determine whether there is significant interaction for the system under study. In this context system elements, variables, states, parameters, end

states, goals states, and teleological and functional systems were defined. The distinctive criterion of teleological explanations was found to be based on "plasticity" i.e., the property through which the system reaches a particular goal by one of a variety of routes. This in turn implies the possibility of reaching the G-state under a variety of circumstances by alternative forms of activity. Functional systems, were seen to be a sub-type of teleological systems in which the goal state is reached through mediation of some specific, prior end state correlated with or necessary to the set of conditions representing the goal state.

System variables were explored in terms of types of change which they may manifest. In this framework variables were defined as full-, part- or step-functions. Variables also make up sub-systems of the supra-system and these sub-systems may be dependent, i.e., influenced by changes in other sub-systems or independent, i.e., un-influenced by changes in other sub-systems. The full-, part- and step-function variables in sub-systems were seen as a means by which a given sub-system could remain out of its goal state during periods in which other sub-systems with goals incompatible with that of the first sub-system were in their goal states.

Five methodological criteria for analysis of teleological systems were provided. These and the remainder of the analysis of teleological and functional systems were then used in analysis of the Gouldner statement on functional theory. In the theory a "principle of reciprocity" is stated which embodies the notion that the less reciprocal the functional interchange between structures the less likely is either structure or the patterned relationship between them to persist unless compensatory mechanisms are present. This principle was found to be tautologous and scarcely subject to test. Analysis of dependent and independent

sub-systems in interaction was demonstrated more useful. Gouldner's second major principle, functional autonomy, refers to the probability that a part can survive separation from the system. This principle according to Gouldner accounts for system tension and change. The analysis indicated that the model of a teleological system with dependent and independent sub-systems which interact, enables analysis of adaptive behavior of systems, their change and persistence while avoiding a number of shortcomings found in the concept of functional autonomy.

CRITERIA FOR SYSTEMS MODELS AND THEIR APPLICATION TO A SOCIOLOGICAL THEORY OF ORGANIZATIONS

By

Gwen Andrew

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Sociology and Anthropology

1961

ACKNOWLEDGMENTS

The author wishes to express her appreciation to the members of her guidance committee for their interest and provocative commentary during the course of the many months required to complete this thesis. These members were, Drs. Donald Olmsted, Chairman, William Form, John Useem, Charles Loomis and Richard Rudner. Among these, two must be singled out for special acknowledgment.

It seems to me that Dr. Olmsted displayed both courage and the highest ideals of professorial leadership when he accepted chairmanship for a student whose topic was not only somewhat different as theses go but also crossed traditional academic boundaries. I wish to thank him for his faith as well as for his hours of pouring over these chapters and his thoughtful suggestions. It was he who remembered the empirical world I had a strong tendency to neglect.

Second, I should like to formally acknowledge the significant contribution of Dr. Rudner. Were it not for his splendid teaching the topic would never have been selected; without his encouragement the thesis would not have come to completion and without his suggestions whatever cogency of argument appears would have been weakened.

Finally, I should like to acknowledge my debt to V. A. Stehman, M.D., Deputy Director, Michigan Department of Mental Health. His understanding support sustained me through the tribulations of a combined student and working woman role.

****

This thesis if affectionately
dedicated to
PEPPONE

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

It will be held in this thesis that social science is formally identical with all sciences in so far as the term refers to a systematized body of knowledge validated by a special method. The purposes of scientific theories, here sociology, are description, explanation and prediction and these are accomplished in a formally identical manner throughout all the sciences.[1] The focus here will be specifically on the logical framework within which the available facts might be organized in a meaningful manner to further the pursuit of these three purposes. In short, the discussion will be methodological in its main tenor. Under this general rubric, the particular methodology explored will be an analytic model for teleological systems which will be found to be applicable to sociological theories of organization. A basic concern of the analysis is the study of a specific theory as a logical structure in relation to other more fully developed theories of the same structure in an attempt to enable advance in the less well developed theory. Accordingly, a major proposal here

---

[1]Description is defined as any non-analytic set of empirically testable statements. Explanation consists of a statement of antecedent conditions, general laws and a description of the phenomenon to be explained. This description must be deducible from the former two sets of statements. Prediction is defined in the same manner as explanation except that it differs in the time perspective involved. Predictions are made, of course, with some success when explanations are not fully adequate. For a detailed analysis of this complex subject see C. Hempel and P. Oppenheim, "The Logic of Explanation," in Readings in The Philosophy of Science, Eds. H. Feigl and M. Brodbeck, (New York: Appleton-Century-Crofts, Inc., 1953).

is that the development of hypotheses from substantive social theories is directly benefited by the use of analytic and/or empirical models.

Problem:

The problem of the thesis is construed as threefold. First, the characteristics of models in general especially in terms of their use as methodological devices assisting the explication of a substantive theory will be explored. Second, the criteria of systems models will be specified. Third, the results of this analysis of systems models will be applied to a specific sociological theory of organization which is couched in the system framework. The divergences between the theory or organization and the interpretation suggested by the analytic system model will be explored in terms of alternative formulations which the analytic model suggests. System theories in sociology will be seen as functional in character and as a sub-type of teleological theories.

The major emphasis of the thesis may be summarized as a demonstration of the usefulness of a methodological analysis using a system model. The sociological theory used for this work will be Alvin Gouldner's commentary on functional analysis, most completely stated in his "Reciprocity and Autonomy in Functional Theory."[1]

In the comments which follow the purpose is to give an outline of the major points which the thesis will attempt to establish. In this introduction there will appear, therefore, statements which are not supported by any evidence but which it will be the work of the thesis to support in the appropriate sections when a detailed analysis of the points involved is provided.

---

[1]Alvin Gouldner, "Reciprocity and Autonomy in Functional Theory," in Symposium on Sociological Theory, L. Gross, Ed., Row, Peterson and Co., Evanston, 1959.

The Use of Models

A model which is to be informative rather than misleading ought to be in a precise and formally specifiable relationship to the theory for which it is to perform its heuristic function. When such isomorphism between model and theory occurs it permits the derivation of new hypotheses or restructuring of faulty hypotheses already formulated. In spite of this fact it will be found that there are a number of current uses of the term model as well as conflicting meanings of the concept. "Isomorphism," "analogy," "homology" and "mathematical models" will be discussed in terms of the differences in their meaning and usage and the meaning of "model" in its most precise sense will be explicated.

A model in the most precise form is a theory the laws of which have the same form as the laws of some other theory to which it stands in the model relationship. When two theories have laws which are of the same logical form they are said to be structurally isomorphic with each other. Structural similarity leads to the consequence that either theory may serve as a model for the other. Obviously, the usefulness of a model in this precise definition comes from the fact that one of the theories is deductively more fully elaborated than the other and can therefore, serve as a device for further deduction of laws in the less well developed theory. This follows from the fact that for every theorem in one of the theories (i.e. the model) there will be an isomorphic counterpart in the other.

In this thesis, however, the model used is a general analytic model, that is, a model which specifies a set of logical properties which obtain for a given type of theory--in this case a teleological theory. Its import is that through it the relationships of logical consequence, for all relevant kinds of system theories, are exposed to analysis. These relationships can then be investigated in a specific empirical theory of social organization.

It will be recognized that there are limitations to the use of models including the time consuming work of articulating the structure of a theory which might turn out to fail as a model for another theory. There is also the inherent danger that because there is considerable knowledge about the model more knowledge may be assumed about the theory than is actually available. In the last analysis it will be necessary to test the hypotheses developed through the assistance of a model application. The model does not verify theory.

Methodological Criteria for System Analysis

A system will be taken to be a conventionally selected set of variables which putatively interact. It will be pointed out that empirical test is required to establish whether the variables selected do indeed interact and whether their interaction is significant for the system under study. This interaction ties the system together, i.e., is the characteristic responsible for "systemness." Definition of a set of relevant concepts used in referring to systems will be given. These are briefly summarized as follows: Elements are the entities of the system which determine the substantive content of the system. Variables are the conditions or characteristics of these elements at given times; these conditions change or vary with time. The values of the variables at any given time define the state of the system at that given time. Parameters are variables in the social or physical environment of the system which interact with the system and which are sources of change in the system through their stimulation of the system variables with which they interact. Parameters of the system are stimuli for system action precisely because social systems are open systems, i.e., the variables are affected by the environment rather than isolated from it.

With these few concepts in mind it is possible to consider the formal methodological criteria which will be developed in the discussion.

These may be discussed in the framework of a set of methodological steps for system analysis which will constitute the summary of the system criteria.

1. Determination that the system to be analyzed is a teleological system.
2. Determination of the goal states.
3. Determination of conditions under which a goal state may be achieved.
4. Specification of empirically possible or likely ranges of variation of the system variables.
5. Designation of sub-systems and their interaction.

Teleological explanations are causal statements referring to systems which display a tendency toward a certain sub-set of all the possible end states which such a system might achieve. One fundamental notion in teleological explanation is that of a causal chain which is an explanation in which the event explained is connected to a previous state of the system which in turn is connected to a preceding state and so on through a chain. These events are labeled end states and teleological systems display a propensity to arrive at one of the possible end states which may be differentiated as a goal state. The causal chain is especially relevant to functional explanations in which an event which marks the goal state of the system is reached through a prior end state necessary to or correlated with the goal state. Other teleological systems may move from a given state to the goal state without intervention of another end state. Such systems may be described in a number of different ways but they are said to be teleological when they are explained by teleological theories.

A distinctive criterion of teleological explanations is reference to some property through which the system reaches a particular goal by one of a variety of routes. This criterion is called plasticity.[1] It implies

---

[1]R. Braithwaite, Scientific Explanation (New York: Harper Torchbooks, Harper Bros., 1960), p. 329.

the possibility of reaching the most probable end state of the system, hereafter referred to as the G-state, under a variety of circumstances by alternative forms of activity. To say that a system will attain a goal state is to say the class of field conditions which lead to the goal will actually occur. Knowledge of the class of field conditions which are necessary to the attainment of the goal state can be arrived at through observations of systems similar to the one in question. Those systems which are in a goal state will react on stimulation by attempting to remain in that state through varieties of alteration in the condition of different system elements.

In order to make a determination of these field conditions or the set of conditions under which a teleological system will either reach a goal or persist in a goal state, it is necessary to know what the goal state is. This requires observation. The teleological nature of the system is specified by a probability statement which indicates the likelihood that a change in one system variable initiated through some stimulus will be followed by an adjustment in other system variables which results in a new set of variable values having an equivalence property to the variable values at any other time the system is in a goal state. In systems which are moving toward a G-state the probability statement is in terms of the degree to which it is probable that if a given variable takes on a certain value other variables will take on values which in combination with the first variable, will "equal" the goal state of the system. (Here G-state refers to the goal-state of the supra system and g-state to the goal-state of sub-systems.)

Functional systems representing a sub-class of teleological systems, arrive at or maintain goal states through mediation of some specific prior end state of the system which is correlated with or necessary to the arrival at or maintenance of the set of conditions representing the goal state. The variable values arrive at an end state and adjust again to eventuate in the goal state.

System variables may display four types of variation. These types are classified on the basis of constancy, a term which refers to a period of no change in value of the variable. A full-function variable has no finite interval of constancy, a part-function has finite intervals of change and finite intervals of constancy, a step-function has finite intervals of constancy separated by instantaneous jumps and a null-function shows no relevant change over the period of observation.[1] All states of the system can be divided into those whose occurrence leads to a change in value of the step-functions and those whose occurrence does not lead to such a change. When the step-function value does change it may be indicative of a critical state for the system--in fact this state may be so critical as to signify system collapse.[2] However, step-function changes may also be a means of adjustment to severe stress and thereby a source of system survival.

The categorization of variables in terms of the type of variation they display lends itself to an explanation of system change as well as to system persistence. Systems do change, they are not in a static arrangement, but this change is in response to stimulation of system variables which through full-, part- or step-function adjustments arrive at a goal state or by a mutual interaction maintain a goal state although the variables themselves have new values. The "sum" of these values

---

[1]W. Ross Ashby, Design For a Brain (New York: John Wiley and Sons, Inc., 1952), p. 80 ff.

[2]Value is used here to refer to the condition of an element at a given time and carries the implication of change or variation. This change need not be quantified nor is it appropriate to prejudge what the value may be. Further, it is not possible to determine which variables are step-, full- or part functions without observation of the variations which do in fact occur. There are, of course, certain instances of system change in which the type of function of given variables might be expected to advance. For example if there were a bureauocratic organization, say an army, in which officers were flouting rules appropriate to their roles and were keeping enlisted men in a state of duress, and if certain other conditions were met, one might expect a step-function change in the enlisted mens conformance to authority arrangements.

continues to be the goal state of the system. This interaction may be conceptualized as adaptation for stability if stability is construed as persistence of a G-state rather than as a merely static relationship among variables.

In the process of a trial and error adaptive variation alternative elements may become more significant for the system relative to its G-state. It is a characteristic of open systems that they can indulge in interchanges with the environment and it is possible that parameters of a system at one time may, at another time, become variables of the system. Since a previously insignificant variable may become important in a functional sense for the system's persistence and since previous system parameters could become system variables it will be suggested here that preoccupation with "functional alternatives" is of doubtful use in system analysis.

Analysis of social organizations requires attention to sub-systems which make up a larger system as well as to simple elements and their variations. Two major points are important with regard to the analysis of sub-systems. First, these sub-systems may be independent, i.e., they may not be affected by change in other sub-systems although changes in them do affect at least one other sub-system. Other sub-systems are dependent, i.e., an action of a sub-system on which they are dependent is followed by action in the sub-system in question. Second, the goal states of sub-systems of the same supra-system may be incompatible. In such a case there must be empirically available some way in which the supra-system can retain its essential wholeness in spite of the incompatibility of the goals of the sub-systems. This wholeness can be maintained by interaction among sub-systems which is based on the variation of those variables which are part- or step-functions. A given sub-system may be kept out of its g-state for a period of time and this will be reflected by a period of constancy of its part- and step-function variables. This period of constancy can account for

accommodation of the sub-system to the incompatible g-state of another sub-system. At another time these part- or step-functions may enter a period of change, moving toward the first sub-system's g-state and requiring that other sub-systems' part- or step-functions enter a period of constancy.

Stimulation from sub-system parameters will account for change in the arrangement among the sub-systems and their part- and step-function variables. There will also be changes in sub-systems which are stimulated internally.

System Criteria and a Functional Theory of Organizations

Gouldner, in his statement on Reciprocity and Autonomy which is the theory to be considered in this thesis, attends not only to thses problems of interrelations among sub-systems but also to the means for selecting system parts. He makes it clear that he is not interested in those systems theories which attempt to be all encompassing and to state a priori the elements which make up the system. Rather he insists on empirical test of the variables and a cumulative building of the set which is relevant for any given system. It will be agreed here that such a process is indeed mandatory but there is some question as to just how Gouldner arrives at any elements for empirical test. It will be suggested that elements must be tentatively chosen on a conventional basis either in terms of common sense observation of the system in question or through a theory which would suggest appropriate elements. However the initial choice is made, the empirical test, reformulation, retest process must follow.

Functional reciprocity is formalized in Gouldner's analysis to a principle that "the less reciprocal the functional interchange between structures, the less likely is either structure, or the patterned relation

between them, to persist--unless compensatory mechanisms are present."[1] He indicates that this reciprocity need not be asymmetrical, that is, the reciprocity need not be directly between two parts of the system but may proceed through a chain. The compensatory mechanisms which may intervene in this reciprocal action are culturally shared prescriptions of unconstrained generosity, cultural prohibitions banning the examination of certain interchanges, power arrangements and mutual sharing of a structure by two others.[2] It will be suggested here that the compensatory mechanisms may be system elements. Certainly the classification Gouldner provides suggests these are norms, sanctions and power. Further this clause appended to the reciprocity principle, since "compensatory mechanism" must be construed as "persistence conducing mechanisms," makes the principle virtually tautologous and hence scarcely subject to test.

The reciprocity principle, in which reciprocity is defined as satisfaction of the system part's needs, implies that Gouldner is suggesting a set of teleological sub-systems rather than a set of elements of a system.[3] It will be concluded that the principle of reciprocity is an unnecessary and confounding principle which could better be omitted from functional theory in favor of an analysis of the dependent and independent sub-systems in interaction. The basis for this statement will be provided in the appropriate chapter but here it may be stated that this is not simply an exchange of names for an essentially similar concept. The reciprocity principle, per se, is a proposition of Gouldner's organization theory which it will be suggested can be replaced by the concepts of dependence and independence.

---

[1]Gouldner, op. cit., p. 249.

[2]Ibid., p. 250.

[3]Since Gouldner does not differentiate clearly between system parts, elements, or sub-systems, it is assumed he means reciprocity to refer to relations between any of these regardless of the accuracy of the assumption stated in this sentence.

The other major principle of interest to Gouldner is what he refers to as functional autonomy. Functional autonomy, the probability that a part can survive separation from the system, varies for the different system parts. Those parts which have the greatest degree of functional autonomy strain to maintain it and this creates system tension since the system strains to reduce this autonomy in order to reinforce its own integrity. The resultant system tension is the source of system change. The system is forced to change either as a means to keep its autonomous parts or through the device of forcing out these parts. Change is the direct result of system tension brought about by intra-system struggles.

System persistence is possible in time of threat by restructuring of the system around its autonomous parts. This restructuring is known as "dedifferentiation."[1] Gouldner offers these statements about systems but at the same time maintains they do not have a goal. The formulation of the notion of satisfaction of needs for system parts would appear to refer to goals of sub-systems although this is not so recognized by Gouldner. The conception of a system struggling to force its parts to behave in one manner or another would also entail the notion of a teleological system in spite of his denial of this for the system as a whole.

It will be suggested here that the methodological analysis of teleological and functional systems provides a useful paradigm for the analysis of systems and leads to useful specifications of testable propositions regarding system persistence and change. A social organization will be seen as a teleological system consisting of a set of sub-systems, some of which are independent and some of which are dependent. Maintenance or achievement of the goals of the sub-systems results in adaptive behavior of those systems dependent upon them and if they, in turn, are dependent they adapt to changes in those systems on which they are

---

[1]Gouldner, op. cit., p. 261.

dependent. Some variables in these sub-systems are part-functions and some are step-functions. Adaptive behavior is accomplished through these types of variables which may accommodate by remaining in periods of constancy while the sub-system is out of its goal state. This adaptation results in a system persistence as long as the stimulus for change is not so disruptive as to force the variables of the system out of the range of variation the system can tolerate. The stimulation for change in systems was seen as coming from system parameters, either parameters of the whole system or parameters of the sub-systems, which could then be variables of other sub-systems.

These pages have briefly outlined the sense of the thesis in relation to the analyses of the threefold problem stated initially. The analysis of Gouldner will attempt to demonstrate the practicability of application of a model as a methodological device and the consequent derivation of alternative hypotheses to explain system behavior. It will consistently be recognized that this derivation does not eliminate the necessity for empirical test of the propositions. That work is yet to be done but as a result of such an application it appears that the empirical work will be more likely to be fruitful. To the extent that the system model clarifies or suggests alternatives for the Gouldner analysis an empirical application of the model will be successful. The reasons for the selection of Gouldner's work for this thesis will be discussed in the appropriate section. There are limitations which must be recognized and a final part of the thesis will elaborate some of them.

CHAPTER II

ASSUMPTIONS UNDERLYING THE ANALYSIS

As stated earlier it will be held here that social science is not different in its formal aspects from any other science and the prefix "social" serves only to announce the content of the area and perhaps the complexity of the field. Science, social or other, refers to a body of systematized knowledge which is validated by a special method known as the scientific method and which has at least the three commonly accepted purposes of description, explanation and prediction.[1] We shall accept these three as the trilogy defining science through a statement of its purposes. Doubtless it need not be added that science is corrigible; its truth claims are subject to correction and are never fully verified. Feigle has put it that "The knowledge claimed in the natural and social sciences is a matter of successive approximations and of increasing

---

[1]The general goal of the scientific enterprise has sometimes been expanded to include the control of the empirical world. We need not try to settle the dispute which arises over this matter of control. Among biologists who have taken the affirmative are Julian Huxley and Gaylord Simpson, who have had something to say about the possibility for man to control his own future through application of scientific knowledge and strongly believe this to be a mandatory effort if mankind is to survive. (See Julian Huxley, Evolution in Action, Harper and Bros., New York, 1953, and Gaylord Simpson, The Meaning of Evolution, Yale University Press, New Haven, 1949). The opposition is ably, though perhaps less convincingly, defended for example, by Leslie White in his entertaining essay labeling the notion of control through science as "Man's Anthropocentric Illusion." (Leslie White, "Man's Control Over Civilization: An Anthropocentric Illusion," The Scientific Monthly, Vol. 6, pp. 235-247.)

degrees of confirmation."[1] But the most important characteristic of science for the problem here is its concern with a coherent structure organizing the available facts in a meaningful manner in terms of the ultimate ascribed purposes, i.e., "Science is concerned with the construction of a system of ideas that is presumed to portray the realm of facts."[2]

Immediately it becomes clear that there must be some criterion for determining what the facts are and how well this constructed "system of ideas" does indeed portray them. It is a commonplace that the broad criterion is empirical test made on the basis of a set of regulative principles to be approximated as nearly as possible in a given situation. These principles include intersubjective testability, reliability, definiteness and precision, coherence and comprehensiveness.[3] In an oversimplified account these may be accepted as self explanatory. The manner by which to approximate these principles is a major occupation of the philosopher of science as well as of the "field" scientist. The scientific method includes three types of verification which need be separated; these are logical, empirical and technological. That aspect with which we are concerned at present is "logical." We are attempting to suggest that studying a theory in terms of its logical structure in relation to other more fully treated theories of the same structure will enable advance in the less well developed theory and this last is a methodological consideration. Further it is our point that this methodological device just indicated will be of assistance in arriving at a more

---

[1]Herbert Feigl, "The Scientific Outlook: Naturalism and Humanism," in Readings In the Philosophy of Science, Feigl and Brodbeck eds. (New York: Appleton, Century, Crofts, Inc., 1953), p. 10.

[2]A. Cornelius Benjamin, "On Defining Science," Scientific Monthly, 68 (March 1949), p. 193.

[3]Feigl, op. cit., p. 11.

satisfactory formulation of hypotheses in the lesser developed theory.[1]

But some will object to the argument that an analytic theory formulated in, e.g., the style of theories from the natural or physical sciences, can serve as a model for theory in the social sciences and before proceeding some of the questions about this issue must be explored. First is the question already alluded to of whether social science is science at all. It has been stated that there are no structural differences. A first means for establishing this is provided by Feigl in his paper "The Scientific Outlook: Naturalism and Humanism."[2] He states and dispenses with certain misconceptions about science. Thus, "Scientific method, while eminently successful in the explanation, prediction, and control of physical phenomena, is distinctly less successful in regard to the facts of organic life and almost altogether hopeless in the mental and social realm. The methods of the physical sciences are essentially mechanistic (if not materialistic) and therefore reductionistic; they cannot do justice to the complex organismic, teleological, and emergent features of life and mind." Feigl's answer: ". . . explanations of the mechanistic type (in one sense of the term) have been abandoned even in physics. But mechanistic explanation in the wider sense of a search for law (deterministic or statistical) is still the indespensible procedure of all sciences that have gone beyond the purely classificatory level. Organic wholeness, teleology, and emergence can be understood, if at all, only by causal analysis on the usual empirical basis. Purposiveness and freedom of choice far from being incompatible with causality, presuppose causal order."[3]

---

[1]We are obviously concerned with the initial phase of verification which will enable development of testable and logically relevant hypotheses. We need not attempt to expand the discussion to the large problems of the means by which the truth value of a given hypothesis may be established since this is outside the scope of the thesis we are attempting to support.

[2]Feigl, op. cit., pp. 10-18.

[3]Ibid., p. 15.

A second misconception: "The methods of science can never replace the intuitive insight or emphathic understanding of the practical psychologist, psychiatrist, cultural anthropologist or historian. This claim is made particularly wherever the object of knowledge is the individual, the unique and unrepeatable." The answer: "It is only through the scientific method that the validity and reliability of the intuitive approach can be gauged. . . . Aside from the mere artistic contemplation of the unique and individual, knowledge, in the proper sense of the word, always means the subsumption of the specific case under general concepts or laws. This holds in the social sciences just as much as in the natural sciences."[1]

While Feigl's answers to the misconceptions appear as adamant as the statements, they also appear adequate. But for all of this the question in its general form seems to be somewhat of a "dead horse." Most objectors do not any longer argue whether social science is science but rather whether it is the same kind of science as the natural sciences; that is, are the methods of the latter appropriate to the social sciences or are they of a different order requiring different methodologies entirely? There is a useful distinction to be made here which may clarify the problem of social science further. The instrumentation of scientific disciplines may differ considerably, e.g., Bunsen burners, test tubes and application of chemicals which act as catalysts and so forth exemplify instrumentation in chemistry as compared with interviews, scales, demographic data and so forth which comprise a part of sociology's technology. The logical method which is called science is common to all disciplines which are scientific.

One aspect of methodology, namely the significance of the degree of complexity of social science is relevant because it has some important implications especially in terms of the appropriateness of systems models.

---

[1]Ibid., p. 16.

Lewis Beck points out that the subject matter of social science consists of "highly complex constellations of complex events in systems that are only poorly isolated. . . ."[1] But he concludes social science is finding means for isolation of crucial variables and ways of studying them at the same time natural sciences are developing techniques for taking more and more variables into account. Beck also contends that the present task of social sciences is determination of "adequate germane categories, such as culture, meaning, function and value; their rigorous definition within the context of social science phenomena; their theoretical elaboration into parsimonious explanatory systems; and the establishment of rigorous procedural rules for their empirical application."[2] It is the "theoretical elaboration into parsimonious explanatory systems" which is the part of Beck's prescription most relevant to the discussion here. It is suggested that careful use of system models may provide a resource by which to make the elaboration in sociology.[3]

Another in this series of questions is that of the level of theorizing which can be accomplished in sociology or more pertinently, the level of theory which is now most fruitful for the field. This is often stated as an argument between theories of the middle range as suggested by Merton and the overarching theories of Parsons. The argument is pertinent to a discussion of the complexity of sociological theory and to these comments about sociology as science to the extent that the use of models may be

---

[1]Lewis W. Beck, "The Natural Science Ideal in the Social Sciences," Scientific Monthly, 68 (June 1949), pp. 386-394.

[2]Ibid., p. 394.

[3]Social science and sociology have been used interchangeably throughout the discussion partially because of the form in which statements are offered in the material quoted and partly because it does not seem imperative to separate sociology from the remainder of the social sciences in any of the general discussion of this thesis. The comments may be considered as applicable to economics, political science or any other field of knowledge which has to do with social phenomena.

restricted to one level of complexity of theory. It may be that the overarching theories are so complex and, presently at least, so lacking in rigor that it is difficult, if not impossible, to apply the methodology of model analysis to them. One purpose in the use of models is improvement in rigor of theoretical formulations but, at least in the logical sphere, it appears that grand scale theories may be so global as to debilitate the effects of such logical analysis. A model, in the sense to be developed here, will be useful in analysis of a theory of bureauocratic organizations. It may be less applicable to a theory of a complex modern society with its multiplicy of variables. This point will be further clarified in the chapter on models. Another point of attack on the level of theorizing in sociology is provided by Blumer. In this context his "sensitizing concept" is pertinent.[1] Blumer finds that there is a divorcement between social theory and the empirical world which is reflected by the fact that theory is rarely couched in terms which permit guidance of research. Data to be sought and connections between facts are not derivable from theory. Further he finds that theory does not benefit from empirical observation and the facts accumulated through it. All of the shortcomings are said to stem from the one major basic problem that concepts in social theory are largely inadequate. "If the concept is clear as to what it refers, then sure identification of the empirical instance may be made."[2] But sociology has failed to find such concepts although there have been serious attempts to develop them. Blumer believes, however, that the concepts derived from these serious attempts suffer from three shortcomings. (1) They fail to have the abstract character of a class with specifiable attributes. (2) The empirical content they isolate is regarded as qualifying something beyond the definitive empirical content--they remain unspecific.

---

[1]Herbert Blumer, "What is Wrong with Social Theory?" Amer. Social Rev., Vol. 19 (Feb. 1954), pp. 1-9.

[2]Ibid., p. 4.

(3) They may have no relevant place in the empirical world under study. He concludes that sociology's concepts are "sensitizing concepts" which are less specific than definitive concepts. The latter "provide prescriptions of what to see" while sensitizing concepts "suggest directions along which to look."[1] He believes that sensitizing concepts are necessary because social science is forced to study the distinctive empirical instance in order to detect common elements which occur in all of them. The sensitizing concept provides a guideline for such study. It would appear that sociology is to concentrate on the development of sensitizing concepts rather than to such esoteric notions as application of systems models. The notion of model implies a position favoring formalization and rigor. The sensitizing concept seems to imply a much more primitive approach, but this does not deny its value. On the other hand how it is to be anything more than a vague and ambiguous "idea" is never explained satisfactorily but it carries a hint of the opinion that social phenomena are inherently different than those of natural science and therefore must be treated differently. The next step is to insist on the subjective nature of social science. Regardless of this possibility Blumer has made a valid point with regard to the complex theories in relation to empirical test but his apparent tendency to use less formalized concepts is the reverse of the point of view here and his position is rejected in this thesis.

Merton in dealing with sociological concepts emphasizes that they do not constitute theory until they are interrelated into a schema.[2] But he specifies a number of functions of the concept. It specifies the data to be observed in an explicit fashion; it leads to reconstruction of data

---

[1]Ibid., p. 7.

[2]Robert Merton, Social Theory and Social Structure (Glencoe: The Free Press, 1952).

which have been available on a trial and error basis and without coherent interrelatedness; it helps the scientist to recognize what he is responding to and what he is ignoring; it serves as an index of unobservables or symbolic constructs exemplified by the concept of intervening variables. Along with insistence on the improvement of definitions of concepts in sociology, Merton believes that "complete sociological systems must give way to less imposing but better grounded theories which apply to a limited range."[1] He would seek to develop special theories which apply to a limited range of data. Ultimately sociological theory must develop its general conceptual scheme through consolidation of groups of special theories. For Merton, the social scientist will provide theories of the middle range but will maintain a pervasive concern with consolidating these special theories into a more general and encompassing theory. This position is consistent with that taken here for it seems clear that systems models will be productive in sociology only to the extent that a selected set of variables in interaction can be studied in a formal manner. Grand scale theory is so all encompassing as to render a system model necessary for it as too general to be useful in application. The most rigorous model will be useful to the extent that it can be applied to a discrete set of variables in a well-defined situation and the fewer of these involved the greater the chance for success from the application of the model.

It is not uncommon for the social scientist to become occupied with the problem of subjectivism in at least two senses. First, it is sometimes argued that the social scientist views his data from a special frame of reference representing his own subjective predispositions which influence the extent of his objectivity. There seems to be no question that the choice of topic for investigation is influenced by personal predispositions--another word for this is interest. But such selection

---

[1]Ibid., p. 7.

is a pre-scientific activity and the question becomes whether the social scientist observes the real world or one of his own making. This question always carries with it the implication that the danger is greater for the social scientist than for those engaged in working with natural science phenomena. This may be a rather meaningless argument in the final analysis. It is suggested that all science imposes a preconception of the nature of reality for that science. There may be more empirical facts from which to begin in one science as compared to another but the process of explanation is essentially the same. It would seem that the question becomes whether or not the concepts work in the sense that they do play a vital part in explanation and prediction. The cannon of reproducibility so firmly imbedded in the scientific method further counteracts this danger of subjectivity.

A second problem which bears on the argument of subjectivism springs from the influence of the observer on the actor he is observing. It is a known fact in the sciences of human behavior that the attention of the observer does, indeed, affect the behavior of the actors under study. Studies of social groups and of isolated individuals have commonly reported this phenomenon known as perturbance. This is not, however, a distinguishing characteristic of social sciences as analysis of the uncertainty relations of modern quantum physics will reveal. Without attempting a discussion of these uncertainty relations, which would lead far afield from the topic of the thesis, it may be suggested that they provide sufficient evidence of the failure to distinguish among sciences on the grounds of the effects of observation on the phenomena to be observed.

The foregoing discussion then has considered a number of questions which are relevant to the problem of the thesis and which it appeared necessary to resolve at least by taking a stated position in order that the reader might be familiar with the underlying assumptions which are

implicitly carried throughout the remainder of the discussion. In short then, the following positions were taken.

1. Sociology is a science.
2. Methodological advancement is a necessary and productive pursuit for the scientist and concern with methodology is a prerequisite to advance although methodology per se does not produce substantive knowledge.
3. It is agreed that sociological phenomena are highly complex and it is difficult to identify appropriate and crucial variables for attention.
4. Middle range or little theories are most likely to prove useful as explanations in sociology at present but they must meet rigorous methodological demands in order that they may ultimately become the basis for more encompassing theory.
5. Models either analytic or empirical, can assist in the derivation of hypotheses for substantive social theories at the level of abstraction encompassed by logical analysis.[1]

Finally, since the thesis is to be methodological in approach it appears appropriate to characterize method and to differentiate it from theory. Here scientific method has the sense of sciences's method or logic of validation. So construed, methodology has among its purposes the clarification of concepts, not their discovery, nor the construction and testing of substantive assertions. The latter is the work of the scientific theorist. The division of science into the context of validation and the context of discovery is useful here. The context of discovery includes that activity which encompasses the development of sets of

---

[1]Chapters 3 and 4 will differentiate analytic and empirical models. Here it may be indicated that an analytic model is one in which the statements are true by virtue of their form while an empirical model consists of a theory which systematically relates sets of laws or law-like statements the truth of which is empirically testable.

statements which are empirically testable. When such statements are systematically related sets of lawlike statements they constitute theory. The context of validation on the other hand, is concerned with the derivation of these relationships, their logical structure, and logical characteristics of evidence statements, and the logic of proof which determines their degree of confirmation.

CHAPTER III

THE MEANING OF MODEL

In the discussion thus far the word model has been used without definition. That served the purpose of the moment but now it is necessary to provide a definition of "model" and to say something of the significance of models for Sociology. While the remarks are focused on sociology they hold for models in general else they do not hold at all if what has been said before has meaning.

Braithwaite generally describes the operation of using a model as follows: ". . . to think about a scientific theory by thinking about a model for it is an alternative to thinking about the theory by explicitly thinking about the calculus representing it. . . . the relationships between the propositions of the model will be of the same kind as those holding between the propositions of the theory, namely relationships of logical consequence."[1] In order to make this more explicit and to arrive at a full definition of model as it will be considered here it is well to provide some definition of terms which are necessary to the discussion.[2]

The language of science consists wholly of declarative sentences. Some of the words in sentences are names for characteristics of individual things or events and of relations among them. These words are called descriptive terms. The subject matter of an area is indicated by its

---

[1]R. B. Braithwaite, Scientific Explanation (New York: Harper Torchbooks, Harper Bros., 1960), p. 92.

[2]The meanings given for these terms are not confined to the work of one author but for the sake of a single reference the reader is referred to the comments in May Brodbeck's paper "Models, Meaning and Theories," in Symposium in Sociological Theory, ed. N. Gross (Evanston: Row Peterson and Co., 1959).

descriptive terms. The connecting words in sentences are logical words. These words give language its form or structure by connecting terms that denote while they themselves denote nothing. The logical words of a sentence, then, give it its form and a sentence may be stripped of meaning by substituting letters for descriptive words and still it will retain its logical form. That retention of form regardless of meaning is an essential part of a use of model which will be explored below. Sentences may be true by virtue of their form alone and when this is the case they are called logical truths or tautological or analytic. Sentences whose truth depends upon their descriptive terms as well as upon their form are called empirical statements or contingent or synthetic.

A concept is a term referring to a descriptive property or relation. A statement of fact is a statement that a concept has an instance or a number of instances. Facts become significant for science when they are connected with other facts to form generalizations or laws.[1] A theory is a deductively connected set of laws. The laws are empirical generalizations of universal form. Laws need not contain metrical terms. The laws which make up a theory are separated into those which are axioms or postulates of the theory and those which are theorems. The axioms are the most general statements in the theory and they imply the theorems. Axioms are not deduced from any other statement of the theory, but the theorems are deducible from the axioms. These are logical conditions of axioms and theorems and have no relationship to their truth value.

Empirical laws are inductive generalizations. Empirical axiom systems or theories are also called hypothetico-deductive systems. Finally, isomorphism is the term for separate theories which have laws that are structurally similar to each other. Isomorphism requires that there must be a one-to-one correspondence between the elements of the two theories and if it is complete isomorphism the theories must operate

---

[1]The "law" may not be a tested or proved generalization in which case it might more appropriately be called a law-like statement but for purposes of discussion the states of knowledge of the truth value of a statement will be treated as synonomous under the term law.

on the same principles. Isomorphism may be more explicitly defined as follows. "Given two classes, S with elements a, b, c, . . . and S' with elements a', b', c', . . . suppose the elements of S can be placed in one-one correspondence with those of S', so that, say, a corresponds to a', b to b' and so on. Thus, if for every relationship R between elements of S (so that, for example, aRb) there is a relation R' between the corresponding elements of S' (a'R' B') the two classes are isomorphic.[1]

It has already been suggested that the term model has many meanings. Isomorphism has also been victimized since it may have several similar meanings. It is now well to clarify some of the overlap of meanings of the notion of similarity as it is reflected in the use of similar terms. Isomorphism refers to an explicit identity. But there are comparative resemblences of several kinds which have tantalized sociology and anthropology during the history of their development and often the confusion has been compounded by helpful scientists from other fields who easily jump from the content of their own theories to those which are the special province of social science. For example we have the distinguished physiologist Walter B. Cannon, who in his book The Wisdom of the Body, develops his theory of homeostasis and then provides a gratuitous translation of biological to social homeostasis in a gross analogy. Thus, ". . . just as in the body physiologic, so in the body politic, the whole and its parts are mutually dependent; the welfare of the large community and the welfare of its individual members are reciprocal."[2] The example could be compounded but it serves to exemplify the use of gross analogy from one theory to another and it doesn't seem to be very "good" sociology. On the other hand, while it seems

---

[1]M. Cohen and E. Nagel, An Introduction to Logic and the Scientific Method (New York: Harcourt, Brace and Co., 1934), p. 139.

[2]W. B. Cannon, The Wisdom of the Body (New York: W. W. Norton and Co., 2nd ed., 1939), p. 310.

unnecessary to take the embarrassment of quoting examples, sociology has certainly drawn at least as gross analogies for itself from organic theories and these haven't yielded very good sociology either.

It appears that while at least part of the problem has to do with the inactiveness of what is meant by such concepts as analogy, homology, isomorphism and model, another part of it comes from the difference of meanings for these terms in the various disciplines. Biology has made much use of the homology which refers to a commonality of organs or organ systems in different organisms and which is interpreted as evidence of identical gene parts or in other words as evidence of a common origin accounting for similarities. Miller, a psychologist, uses the term homology to refer to a formal identity between two "real" systems as opposed to that between two "conceptual" systems which he calls an "isomorphy."[1] Bertalanffy refers to logical homologies which are phenomena differing in the facts involved but governed by laws that are structurally isomorphic.[2] Analogy is used in biology to mean resemblances arising independently of each other through the action of natural selection on different genetic systems. Only general resemblences between analogues are to be expected.[3] Miller uses this term to apply as a sort of class term for any of these relationships and recognizes its ambiguity which he hopes to clarify somewhat by use of the term "formal identities."[4] For Bertalanffy the analogy is apparent similarity of phenomena which correspond neither in active factors nor in the governing laws.[5]

---

[1]J. G. Miller, "Toward a General Theory for the Behavioral Sciences," American Psychologist, Vol. 10, No. 9 (Sept. 1955), p. 520.

[2]L. von Bertalanffy, "General System Theory: A New Approach to Unity of Science," Human Biology, Vol. 23, (1951), p. 308.

[3]A. E. Emerson, "Dynamic Homeostasis: A Unifying Principle in Organic, Social and Ethical Evolution," The Scientific Monthly, Vol. 78, No. 2, (Feb., 1954), p. 70.

[4]Miller, op. cit., p. 520.

[5]Bertalanffy, op. cit., p. 308.

Discussing mathematical models, the "queen" of all desirable models, Rapoport points out that "Outside of mathematicized sciences, the term 'model' often refers to an anological explanation. . . . Their explanatory value, if any, is in the appeal to see in a seeming similarity of two phenomena the explanation of the unfamiliar one in terms of supposed understanding of the familiar one. With such constructs, mathematical models have only one thing in common--the property of 'as-if-ness.' Mathematical models also rest on fiction, on appeals to look at events as if the underlying 'causes' had a certain structural analogy to the model proposed. But there the similarity ends. The mathematical model invariably leads to specific relationships among specific variables."[1]

To refer to a model, mathematical or not, simply as an analogy would then seem to be a loose meaning for "model" indeed. What then is a model? We could redefine analogy in a formal way and have the term to use but it would perhaps be more useful and least ambiguous to confine our terminology to the word model. "If the laws of one theory have the same form as the laws of another theory, then one may be said to be a model for the other."[2] When two theories have laws with the same form they are isomorphic or structurally similar to each other. If two empirical theories are isomorphic either may serve as a model for the other. Obviously, the most completely articulated theory would assume the role of model in any practical application of the principle of models. In addition to two empirical theories structurally isomorphic it is common to use an analytic or mathematical theory as a model. The advantage of the mathematical model is that it is true by definition and serves the heuristic purpose of enabling deductions in the empirical model. If the mathematical theorem is not satisfied in the empirical

---

[1]A. Rapoport, "Uses and Limitations of Mathematical Models in Social Sciences," in Symposium on Sociological Theory, ed. L. Gross, (Evanston: Row, Peterson and Co., 1959), p. 354.

[2]May Brodbeck, "Models, Meanings and Theories," ibid., p. 379.

theory, that is, if the empirical theorem fails, this indicates that some one of the axioms of the empirical theory which corresponds to a mathematical axiom is false. Mathematical models are not of primary importance here for it appears unlikely to find a mathematical model for use in any one-to-one sense with a sociological theory at present.[1] There are however, theories which like mathematics are true by virtue of their form just as there are sentences of the analytic form as mentioned earlier. These too may serve as models. In these analytic theories used as models the axioms of the theory are analytic. An additional kind of general analytic model, that is to be used here, is concerned with specifying the set of logical properties which any teleological theory or appropriate model has. Here a set of conditions which explain teleological or functional systems (which latter will be shown to be a special case of teleological system) will be specified. Any theory which is teleological will then, have certain logical properties consistent with these conditions. For the moment the analytic theory might be termed a theory of systems--it is a system model--a teleological system--with which we are concerned. There are criteria which define a teleological system which will be developed in Chapter IV where the vague relations between system and

---

[1]There have been attempts in this direction. George Zipf's principle of least effort: "Individuals and societies act so as to minimize the expected average rate of work," has been called a mathematical model. This is using the term model to refer to arithmetic representations but it is doubtless more accurate to label Zipf's principle as an attempt at quantification. Kenneth Arrow has suggested that "the fundamental postulates are nowhere stated explicitly; though mathematical symbols and formulaes are sprinkled through . . . the derivations involved are chiefly figures of speech . . . rather than true mathematical deductions. . . ." ("Mathematical Models in the Social Sciences," in The Policy Sciences, ed. D. Lerner and H. Lasswell (Stanford University Press, 1951), p. 149). A more precise attempt was carried out by Herbert Simon using Homans Human Group (H. Simon, "A Formal Theory of Interaction in Social Groups," in Small Groups, eds. P. Hare, E. Borgatta, R. Bales, New York: Alfred A. Knopf, 1955, pp. 132-148). He quotes Homans as concluding that the mathematical treatment did no violence to his meaning but it failed to capture all of the interrelations of his postulates (ibid., p. 135).

theory we are presently allowing will also be clarified. Any teleological system will be said to be a replication of these criteria of the analytic system regardless of the substantive field.

When empirical theories are used as models for other empirical theories two criteria may be used. First, there must be a one-one correspondence between the descriptive concepts of the model and those of the theory. Second, once the descriptive terms of the two theories are in precise correspondence formal similarities, that is the connections between the concepts,have to be preserved. This second step is that of interpreting the same calculus. Here, using a general analytic model the correspondence of descriptive terms demanded when empirical theories are used as models is irrelevant. Terms which replace descriptive terms will be such words as "elements" and "variables" which have a synonomous meaning in any theory. We are proceeding on the assumption that the analytic teleological system can serve as a model for a teleological system theory in sociology; specifically a theory of bureauocratic organizations. In explicating the characteristics of teleological systems we will be determining the logical properties of these systems. In so far as the logical properties of an empirical system are consistent with conditions characterizing the teleological system model the empirical theory will be an accurately worked out deductive system. In other words the theorems or hypotheses of the sociological theory will meet the demands of the criteria of teleological systems.[1] To the extent that this is not the case adjustment will be required if the theory is to have explanatory and predictive power. Further, if the empirical theory is constructed to be isomorphic with an analytic theory it may be possible through the latter to recognize relationships suggestive of substantive hypotheses for empirical test in the sociological theory. In this sense the formal

---

[1]This statement holds only for those sociological theories which are teleological in character of course.

model will serve a heuristic purpose assisting in derivation of theory whereas if it is used to demonstrate errors in conception it will serve a corrective function.

Finally, if the empirical theory is not isomorphic with the model it may be that it is not a teleological theory encompassing a teleological system. Should this be the case then statements in the theory couched in terms of teleological systems would need to be rephrased with a different underlying conception. It is assumed here that lack of the model relationship, if found, will be due to neglect of the exercise of carrying out appropriate deductions.

To illuminate the morass of terminology let us elaborate a convenient example from Brodbeck. ". . . suppose it is wondered if rumors spread like diseases. . . . do the laws about rumors have the same form as the laws about diseases? The descriptive concepts in the laws of epidemiology are first of all replaced by letter variables. This reveals the form of the laws. The concepts referring to diseases are put into one-to-one correspondence with those referring to rumors. This results in a set of hypotheses about rumors, which may or may not be confirmed. If, optimistically, these laws are confirmed, then the two theories have the same form."[1] This is use of an empirical theory as a model. In an analytic model such terms as "rumor" and "disease" would be replaced by the term "elements" and "spread like" would be labeled a "variable," since no empirical elements or variables exist in the analytic theory.

Perhaps it would add something to the definition of model to make some statement of what it is not. Model has been used to refer to theories which have certain characteristics. These are theories which are not yet tested--they are in a stage of uncertainty; those where a selection of variables is entailed as is always the case but in some instances with

---

[1]Brodbeck, op. cit., p. 379.

self-consciousness on the part of the investigator; theories which encompass ideal entities and those which are expressed in arithmetic terms. These characteristics are to some extent part of most theories. Model in the terms used here includes none of these conceptions.[1]

Since it is "good" to use models it will also be "good" to point out that there are limitations on their use. In the first place it is no simple task to fully articulate the underlying calculus and axiom structure of the theory to be used as a model especially if an empirical theory is used. It is a time consuming and perhaps uneconomical work. This is a practical limitation. A second problem is the danger that the theory will be identified with the model so that the objects with which the model is concerned will begin to be assumed to be the same as the descriptive concepts of the theory. This danger, inherent in the use of empirical models is that of assuming much more knowledge about the theory than is actually available because of a kind of identification with the knowledge that is available for the model.[2] For example in using an empirical theory of the flow of water through a pipe as a model for a theory of electricity concerned with the flow of electric current in a wire, only the relevant properties of water (e.g., those concerning its "flow" properties) can be "transferred" to the theory of electricity. The danger consists in transferring somehow additional knowledge of properties of water, that it is wet or has thirst quenching properties, into counterparts in the theory for which water flow in a pipe is being used as a model. This danger seems very great for models in sociology as was suggested earlier in the references to various analogies which have been made between human physiology and social systems or between biological and cultural evolution.

A special case of this possible error in the use of models is also referred to by Braithwaite who calls it a second danger. This has to do

---

[1]See Brodbeck for an expanded statement of these common misuses of the term model. Ibid.

[2]Braithwaite, op. cit., p. 96.

with imputing logical necessity to statements corresponding in the theory to logically necessary statements of the model. This error is based on the possibility of interpreting the underlying calculus of the theory as a logically necessary model. As such it is not directly pertinent for the general model of teleological systems being discussed. The general model being discussed here consists of a specification of the conditions which any such system must meet. The error to which Braithwaite alludes, then, is one which occurs when the investigator insists on applying the logically necessary properties of statements of the model to statements of the empirical theory and thereby changes the contingent character of the theory. Finally, and more pertinent here, Hempel in referring to the conceptions of the general system theorists warns concerning the legitimate expectations of model applications. "It does not seem to me, . . . that the recognition of isomorphism between laws adds to, or deepens, our theoretical understanding of the phenomena in the two fields concerned; for such understanding is accomplished by subsuming the phenomena under general laws or theories; and the applicability of a certain set of theoretical principles to a given class of phenomena can be ascertained only by empirical research, not through pure system theory. . . . for theoretical understanding is reflected in the ability to predict and the latter obviously remains unchanged by the recognition of isomorphism."[1] This strongly stated caution is congruent with the point we have already established here where it was stated that the use of models is in a methodological context and that models in themselves do not produce theory in a substantive field. Hempel states it again, "But while system theory surely cannot supply us with a set of overall principles which

---

[1]C. G. Hempel, "General System Theory and the Unity of Science," Human Biology, Vol. 23, (1951), p. 315.

deductively imply the solution to all (e.g. growth, and homeostasis, thermodynamics) special problems, it is well possible that the general mode of approach advocated . . . will prove a highly useful heuristic guide in the search for the solution of specific theoretical problems."[1]

---

[1] Ibid., p. 317.

CHAPTER IV

CHARACTERISTICS OF TELEOLOGICAL SYSTEMS AND METHODOLOGICAL CRITERIA FOR SYSTEM ANALYSIS

The previous chapters have attempted to illuminate certain basic considerations underlying the major proposition of this thesis; namely that a precisely articulated conception of a system theory can serve as a model with heuristic consequences for an empirical theory of organizations. Heuristic is taken to mean fruitful for the methodological aspects of derivation and specification of hypotheses testable in an empirical setting. It is now necessary to develop this articulation.

It appears unnecessary to prove the proposition that much if not most of sociological theory has a system conception inherent in it. But it is perhaps useful to indicate some of the references to systems in current sociological literature. A case in point is provided by Blumer in a critical discussion of what he refers to as "variable analysis" in sociology.[1] While his position is not entirely clear it does appear that he is leaning toward a system conception in sociological analysis when he deplores attention to "the variable relation [which] is a single relation, necessarily stripped bare of the complex of things that sustain it in a 'here and now' context."[2] Or again, "there can be no doubt that, when current variable analysis deals with matters or

---

[1]H. Blumer, "Sociological Analysis and the Variable," American Sociological Review, Vol. 21, No. 6 (Dec., 1956), pp. 683-690.

[2]Ibid., p. 685.

areas of human group life which involve the process of interpretation, it is markedly disposed to ignore the process."[1] And finally, "I think it will be found that, when converted into the actual group activity for which it stands, a sociological variable turns out to be an intricate and innermoving complex."[2] Blumer appears to be arguing that the interrelations of variables are intricate and that the process of this interrelation must be attended to and this in turn seems to imply a system within which the processes go on--for Blumer the system is human group life.

On a more general level but more explicitly Meadows has stated that system is the ". . . master model of science. We think in terms of systems. The scientific enterprise represents a commerce between empirical and conceptual systems."[3]

A perusal of Sociology Today, a volume which attempts to summarize contemporary sociological thought, quickly reveals the sociologists' interest in systems and something of the variety of general definitions involved.[4] Parsons, of course, discusses systems at length in his chapter on General Theory. His statement is much too complex for our purposes at the moment; suffice it to say that he sees social systems as structurally differentiated about two major axes, the first that between the "external" and "internal" references and the second the "instrumental-consummatory axis." There are four levels of organization of social systems: primary or technical, managerial, institutional and societal. This scheme of levels is seen as constituting a continuous series in which

---

[1]Ibid., p. 686.

[2]Ibid., p. 689.

[3]P. Meadows, "Models, Systems and Science," American Sociological Review, Vol. 22, No. 1 (Feb., 1957), p. 3.

[4]R. Merton, L. Brown, L. Cottrell, Jr., eds., Sociology Today (New York: Basic Books Inc., 1959), 623 pages.

each level is systematically related to adjacent levels. He states a method of approach to the analysis of systems in typical phraseology--"The main analytical device I have used here for building such a continuous series is the repetition at each level of the same basic paradigm of system structure and functioning, on the assumption that the relations between higher and lower order systems are those of system and subsystem in an order of differentiation and segmentation."[1] A given system model then, is useful at all levels of organization. This is an important agreement with what is being said in the present analysis.

Paul Lazarsfeld refers to systems through his paper on Problems in Methodology from which the following provides a summary statement: "Competent social research deals with more than two variates; consequently, it emphasizes, not a single relation but a system of relations, and often it studies their interaction over time."[2] Riley and Riley discussing Mass Communication and Social Systems refer to studies of formal organization and choose the Western Electric investigations as an example of work dealing with an industrial plant as a social system. "This system is composed of a technical organization and a human organization, each of which affects the other. The human organization, in turn, is subdivided into formal and informal social organizations. Within such a system research observations indicate the processes through which the informal groupings of friends and co-workers may function either to support or to detract from the formal organization's goal of efficient productivity."[3]

In the chapter on Race and Ethnic Relations, Simpson and Yinger indicate that ". . . Society is a system of interrelated parts. The processes that go on are relevant to the maintenance of that system.

---

[1]Ibid., p. 16.

[2]Ibid., p. 67.

[3]Ibid., p. 555.

When major changes occur, they are felt throughout the structure; but, oppositely, if changes in one part are not supported by others, their effects can be sharply curtailed."[1]

In the Sociology of the Family, Goode describes three types of theory development and indicates that in Type III there is a treatment of some unit in the subfield as a hypothetically closed system, under certain restrictions. The important variables which define that system are studied in an attempt to locate interrelationships among them. Kinship structure is an example of a subfield within which such a procedure is used. Murdock's Social Structure is cited as an important example.[2]

Gouldner in his incisive discussion of organizational analysis defines the natural-system model as he believes it is viewed although he does not entirely accept it. "The natural-system model regards the organization as a "natural whole" or system. The realization of the goals of the system as a whole is but one of several important needs to which the organization is oriented. Its component structures are seen as emergent institutions, which can be understood only in relation to the diverse needs of the total system. The organization, according to this model, strives to survive and to maintain its equilibrium, and this striving may persist even after its explicitly held goals have been successfully attained.[3]

Loomis has recently published a set of essays which analyze a variety of social phenomena in terms of his conceptual scheme labeled the "Processually Articulated Model."[4] This model is used as an analytic tool in the examination of social systems and is based upon a set of empirical entities found to be appropriate for any social system.

---

[1]Ibid., p. 384.

[2]Ibid., p. 178.

[3]Ibid., p. 405.

[4]Charles P. Loomis, Social Systems (Princeton, N. J.: D. Van Nostrand Company, Inc., 1960).

These entities include nine elements which make up the structure of a social system and a set of processes which "mesh, stabilize and alter relations between elements."[1] The processes are categorized into specialized processes which "articulate the separate elements" and a set of "master processes which activate many or all elements."[2]

The focus of the scheme is directed on analysis of change, persistence and development of social systems.

This work represents a comprehensive analysis and synthesis of much of the empirical data which has been produced in sociology and it demonstrates the use of a model as a device for analysis.

Amitai Etzioni provides a pertinent reference to system analysis which is important for its gentle but insistent suggestion that the "system model" is the most appropriate methodology for study of organizations.[3] He contrasts what he calls the "goal model" which confronts a social unit with an ideal and then grades it according to its degree of conformity to the ideal" with the system model which "sees the social unit as a process and proceeds to determine the external and internal conditions that enable it to function."[4] In addition to his development of the notion of the system model Etzioni makes some further observations which are pertinent to the point here. He obviously uses the term model in a somewhat different sense than has been defined herein. For Etzioni the system model

---

[1]Ibid., p. 6.

[2]Ibid., p. 7.

[3]A. Etzioni, "Two Approaches to Organizational Analysis: A Critique and a Suggestion," Administrative Science Quarterly, Vol. 5, No. 2, (Sept., 1960), pp. 257-278.

[4]Ibid., pp. 260-261.

is constructed by the student of a particular organization and in terms of that organization. He indicates that the system model often requires "considerable knowledge of the way in which an organization of the type studied functions."[1] And he goes on to suggest that getting this knowledge is not wasted effort since the data can be used in study of other organizational problems. But it appears that he is suggesting an independent model for each organization studied--independent in the sense that, while past experience with system models approaches to organizational analysis will be invaluable as an aid, the actual model will have to be constructed anew for each new organization. He does allow that "In cases where the pressure to economize is great, the theoretical system model of the particular organizational type may be used directly as a standard and a guide for the analysis of a specific organization. But it should be pointed out that in the present state of organizational theory, such a model is often not available. At present, organizational theory is dealing mainly with general propositions which apply equally well but also equally badly to all organizations."[2] With this point there is no disagreement but Etzioni goes on to make a rather devastating observation: "The differences among various organizational types are great; therefore any theory of organizations in general must be highly abstract. It can serve as an important frame for specification, that is for the development of special theories for the various organizational types but it cannot substitute for such theories by serving itself as a system model, to be applied directly to the analysis of concrete organizations."[3] This comment is not quite so much at variance with the position of the argument here as it first appears. It is somewhat akin to the opinion that the general systems theorists who look for a system model to be applied not only to

---

[1]Ibid., p. 270.

[2]Ibid.

[3]Ibid.

such possibly diverse phenomenon as different types of organizations but to all of science are working at so general a level as to make their efforts of little immediate practical value to the working scientist. The danger of such a grand model is that it will be forced to such abstraction that the conception of system becomes quite powerless. The purpose here is to develop criteria for system analysis which can be used with immediate empirical problems. We would expect it to be useful in the methodological work of theory building and empirical analysis of organizations as different (or alike) as an industrial plant, a government bureau or an academic department.

Discussion of systems in an abstract sense has, of course, not been confined to sociology. Scientists of a variety of disciplines have been occupied with specification of a generalized or abstract statement of systems which would be presumed to be applicable to a variety of fields. There has been the emergence of the General System Theorists who are devoted to the development of general models since they believe that the more advanced sciences have been largely based upon suitable model conceptions. "General systems theory will be an important means to facilitate and control the application of model conceptions and the transfer of principles from one realm to another."[1] Bertalanffy and his followers are inclined to the position that the world shows a structural uniformity with isomorphic traces of order in its different levels. Miller attempts to establish general behavior systems, extending roughly from viruses through societies.[2] Boulding sees general systems as a means by which scientists of various disciplines may "catch relevant communications" from those in other fields. This communication will permit learning from one science to another. His approach would include (1) analysis of phenomena which are found in many disciplines and a search to build

---

[1]Bertalanffy, op. cit., p. 305.

[2]Miller, op. cit., p. 513.

up general theoretical models relavant to these phenomena, and (2) an arrangement of empirical fields in a hierarchy of complexity of organization of the basic units of their study in order to develop a level of abstraction appropriate to each."[1]

---

[1]K. Boulding, "General Systems Theory--The Skeleton of Science," Management Science, Vol. 2, (1956), p. 13.

One of the more interesting complicating arguments which has perhaps inevitably, followed this concern of various disciplines with system theory but which is of only passing interest here, is that of the levels of integration in a hierarchy of sciences. This argument has also taken on overtones of ethical positions. Novikoff has complained that some biologists have blurred the distinction between biological and sociological phenomenon which are to be studied as two distinct levels of integration and interrelationship. The blurring leads to an anthropormorphism and to "mystical often dangerous statements about society!" (A. Novikoff, "Concept of Integration Levels in Biology, Science, Vol. 101 (March 1945), p. 212). Gerard takes the position that there is a hierarchical arrangement of the sciences with a distinct structural analogy from one level to the next. He finds that those who do not accept this hierarchy of systems are attempting to separate human from the rest of biology almost completely. Gerard has also taken the position that the trend of evolution confirms the organic nature of the state and this establishes an ethical basis for promotion of the strong state (R. Gerard, "A Biological Basis for Ethics," Philosophy of Science, Vol. 9 (1942), pp. 92-120). Another distinguished biologist, Gaylord Simpson, takes exception to the "organismic" position. "When the state or any other social structure is called an "organism" the word is being used in a way fundamentally different from its use in biology. Use of the concept as an analogy is interesting but a misuse of analogy confusing it with equivalence. Furthermore . . . it is quite evident that merging of the individual into a higher organic unit is not a common trend in evolution and specifically, is not at all a trend in human evolution" (Simpson, op. cit., p. 153). He sees physical, biological and social sciences as concerned with quite distinct kinds of organizations with sharply increasing orders of complexity each including the lower grades. Failure to make this distinction leads to the notion that biological evolution provides the basis for determining the directions of action along the lines seen as comparable to those of biology. It can also lead to inactivity on the assumption that if the forces of evolution are permitted to hold sway government will evolve in the "appropriate" direction. Either of these can be a dangerous misapplication of the principles of evolution and organization in biology to the detriment of the society.

Interesting as the argument may be, and it is much oversimplified here, its major importance to this discussion is the exemplification of the possible misuses of a model conception leading to attribution of characteristics of one substantive area to another.

It is the work of this chapter to specify the characteristics of systems in order to develop a system model for application to an organization theory in sociology. The problem is that of determining which characteristics of systems are relevant for such a model--there is no pretense that a general model applicable to all types of systems will be provided. A definition of organization will improve understanding of what follows. An organization here, is a bureaucratically arranged social group with at least one specifiable goal. Bureaucratically arranged means a group with members with differentiated functions relative to some goal of the organization.

A system will be taken to be a conventionally selected set of variables which interact. This set of interacting variables may be (and doubtless will be) a sub-set of a larger set of variables or in other words the system chosen for study may be a part of a larger system. While this is the case, the sub-system will nevertheless be viewed as a delimitable unit consistuting a separate system. Whether the variables conventionally selected do indeed interact, and whether their interactions are the significant relationships for the system in question is a matter of empirical test but some common sense selection must precede analysis. The interaction or interrelationship of the variables is the "behavior" which ties the system together or in other words constitute the processes of the system.[1]

The selection of variables may be simple enough in certain of the sciences, at least in later stages of the development. Social sciences on the other hand, have no simple task to make this identification of the relevant variables of the systems they wish to study. Element identification may be viewed as a part of the context of discovery while the empirical test of this selection falls in the context of verification.

---

[1]This definition of system conforms to that provided by most commentators. See for example, Hall and Fagan, Miller, Bergman, Ashby.

There is a distinction to be made between the elements of a system and the system variables. The elements or entities of the system reflect its substantive content--they indicate whether the subject matter is physics, psychology or sociology for example.[1] They are the descriptive terms. Variables are the conditions of these elements at given times and carry the implication of change or variation regardless of the precision with which this change can be quantified or indeed measured. The sun is an element of the solar system, its location at any given time is a condition of the element and therefore is a variable.[2] In a bureaucratic organization an element might be power; the extent of power, however measured, is the variable.

Each system, if it is to be a system, must have certain variables which are closely interrelated and which by adjustment of their interrelationships account for the survival of the system. These variables may be called the essential variables of the system after Ashby.[3] The values of these essential variables and any other variables which the investigator has included in the system define the state of a system at any given time. Or to put it in terms of the elements, the condition of the elements of the system defines the state of the system at any given time.

---

[1]It has been suggested to the author that this is not necessarily the case for different substantive areas may have the same elements. Some sociologists and some psychologists consider "goal" as a system element. This appears to be related to the level of abstraction involved. If the element goal is defined for a given system the terms used for definition will then specify the substantive area under consideration. The extent that a given set of elements are specified for systems and are applicable to more than one substantive area may be a reflection of the extent to which the theory is a general system theory.

[2]W. Ross Ashby, Design for a Brain (New York: John Wiley and Sons, Inc., 1952), p. 14. Ashby has defined a variable as a measurable quantity which at every instant has a definite numerical value. While this adds precision I am not persuaded it is a necessary precision nor that sociological variables can as yet be so restricted. Whether they will ever be is another question.

[3]Ibid., p. 41.

When we refer to the value of a variable all we imply at the moment is that the variable can be measured in some way along the lines suggested above.

A system other than the entire universe operates in an environment. There are at least two ways of viewing this environment. Using a given organization as a system one way of considering it is to determine those variables which are outside the formal organization but which interact with it and to hold these as the environment of the system. Another way is to accept these outside variables as environment of the organization but to hold that the organization variables and the environmental variables make up an absolute system in the sense of a set of variables which are then existent without relation to any other thing or as self sufficing and disengaged from interrupting causes. The former method, which appears preferable, would specify the system on the basis of the variables considered a part of the organization and would consider all variables outside the organization but acting upon it as the environmental variables or the parameters of the system. All the variables of an organizational analysis would then, be divided into two classes; those which are within the system and are labeled variables and those which are outside the system but interact with it and are labeled the parameters. Parameters have varying extents of relationship to the system; change in some will affect the system to a great extent, others will have a minor effect if they change in value and some will have no appreciable effect at all. The task is to determine those which are significant for the system and this again, beyond an initial common sense selection, is based on empirical test. One would hardly be too concerned with the phases of the moon in so far as they might effect a Federal bureau of education; there would be an area of probability subject to test with regard to the influence of the political affiliation of the incumbent members of congress. The parameters of the system are exceedingly important since in a dynamically operating system, persisting in space, change of the system

comes through change in its parameters as well as from internal stimulation.

To this point we have defined system, elements, variables and parameters and have implied that these are the basic parts of system models. The next problem is to consider certain of the more complex questions concerning the behavior of systems and to settle their complexities for the purposes of application of systems models in sociology of organizations.

We begin with some rather general conceptions of system processes. A rather easily dispensed with problem is the differences between static and dynamic systems. In fact probably the only major problem here is the looseness with which the term dynamic has come to be used. A static system will be considered as one in which the condition of the elements does not change with time or in other words the relationship between variables persists in the same form and intensity. A dynamic system is one in which there is a change in the interrelationship of the variables over time. Since it is doubtful if there are social systems which do not show variation the focus of attention here will be on dynamic systems.[1]

Open and closed systems are a second dichotomy which is sometimes considered as a significant factor differentiating between the systems of physics and of biology and sociology. Closed systems are said to be the systems of conventional physics. These are systems which are isolated from their environment, there is no import or export of material from them, and their final state is unequivocally determined by their initial conditions.[2] Or as Bergman defines it a closed system is one in which what happens inside the limited piece of space which is a

---

[1]The static social system would exist only in an historical sense as the terminal state of an extinct society.

[2]L. Von Bertalanffy, "General System Theory," General Systems, Yearbook of the Society for the Advancement of General System Theory, Vol. 1 (1956), p. 3.

system is not affected in any way by any factor outside of it.[1] An open system exchanges materials with the environment and it has the basic characteristic of self-regulation. Materials is taken to include energy or information. Organic systems are open systems since they have this exchange with environment and social systems have the same characteristic.[2] This characteristic of openness has been seen as having important implications for system models. In the closed systems of physics the laws of thermodynamics are applicable. It is the so-called second law which has posed some question for the biological and social systems theorists. This law states that the accomplishment of work by a system requires not only a change in the distribution of heat, but also an actual consumption of heat and the amount of work so obtained is equivalent to the amount of heat lost. This heat becomes unavailable energy in the system and the term entropy is used as a quantitative expression of this unavailable energy. In a closed system as work is performed entropy increases or in other words the entropy of the whole system tends to a maximum.[3] "The general trend of events in physical systems is toward states of maximum disorder and leveling down of differences with the so-called heat death of the universe as the final outlook, when all energy is degraded into evenly distributed heat of low temperature and the world processes come to a stop."[4]

But it has been observed that there is an increasing order in vital systems. Evolution for example, tends toward increasing complication

---

[1]G. Bergman, Philosophy of Science (Madison, Wis.: University of Wisconsin Press, 1957).

[2]L. Von Bertalanffy, "The Theory of Open Systems in Physics and Biology," Science, Vol. III, (Jan. 1950), pp. 23-29.

[3]W. P. D. Wightman, The Growth of Scientific Ideas (New Haven, Yale University Press, 1953), p. 283.

[4]Bertalanffy, General System Theory, op. cit., p. 4.

and this contradicts the second law.[1] Bertalanffy argues that the notion of open and closed systems accounts for this apparent difference in that the second law holds for closed systems but in open systems energy may be imported from the environment and entropy may be reversed.[2] Hall and Fagen agree that the open system seems to contradict the second law but believe that if the open system and its environment are considered as a whole the contradiction disappears and the second law holds.[3]

Lienau in contemplating the quantitative aspects of organizations concludes "We are brought to the concept of social organization as a mathematical function . . . of variables measuring internal differentiation, and integration of the whole. This is analogous to the concept of entropy as a mathematical function of physical variables: of work done, heat energy exchange and temperature or the state of probability (disorder) of the system."[4]

Leslie White's "energy theory" is an attempt to apply the second law in social science.[5] In brief, he believes that accomplishments of cultural systems are in proportion to the amount of energy harnessed and put to work. This is capture of free energy and maintenance of the system by taking advantage of the "cosmic flow of energy downward." Energy is harnessed culturally with technology. Social systems, being functions of technological systems, evolve in their ideological aspects, as technology

---

[1]Ibid., p. 4.

[2]Ibid., p. 4.

[3]A. Hall and R. Fagen, "Definition of System," General Systems, Yearbook of the Society for the Advancement of General Systems Theory. Vol. 1, (1956), p. 22.

[4]C. C. Lienau, "Quantitative Aspects of Organization," Human Biology, Vol. 19 (Dec. 1947), p. 209.

[5]L. White, "The Energy Theory of Cultural Development," K. Kapadia, ed., The Ghurye Felicitation Volume (Bombay: Popular Book Depot, 1954), pp. 1-10.

develops. He concludes that the increasing entropy of one set of systems is capitalized upon by another. This does not seem to be quite the same distinction as that made by proponents of the open and closed system dichotomy who merely suggest that increasing entropy is inevitable in closed systems but reversible in open systems.

Whether social and cultural systems use energy from other sources in White's terms or whether they can be seen to conform to the second law if enough variables are taken into the system or whether it is appropriate to attempt to get an expression of a mathematical function for social organizations analogous to entropy in physical systems are interesting enough questions but their relevance here is tangential. The second law and the concept of open and closed systems in relation to it point up the significant difference in the systems of physical and natural and social science. Consideration of the import of the consequences of the theory of thermodynamics in closed systems and the apparent difficulties of even analogous application of it to theory in social systems stresses the necessity for models which not only account for intra-system variable relations but also pay attention to the parameters of the system as non-isolatable effectors of system reaction. It appears that to solve one major problem of complexity it is preferable to view social systems as open systems with influence from the environment rather than to attempt to treat them as more encompassing closed systems where parameters of the system become part of the internal variables. This would lead to almost endless expansion of the system attended to. Open systems increase in complexity and tend toward higher organization because of the interaction of variables and parameters. This is the first inference to be drawn from tha analysis of the second law.

A second relevance of this discussion is the relationship of the second law from classical physics and the closed system notion to determinism. In a closed system such theories as thermodynamics are based in part on the fact that the final state of the system is determined

by its initial conditions and this final state, or the state at any time is predictable. But in open systems variable interrelationships are influenced from outside the system. Is it possible then, to predict the state of an open system at one time from a statement of its state at another? This is an important question for social system theory for we have found it to deal with open systems. To reach a decision it is necessary to delve into some of the more basic aspects of determinism.

"A determinist asserts the world is 'comprehensively lawful.'"[1] This conception underlies or provides the frame of reference for all science. But this assertion in this form is so broad that it fails to be very useful. The term deterministic is better applied to a theory referring to a set of variables of a system and not to the system per se. It is the theory, not the system which is deterministic. Thus a deterministic theory is one with a particular logical structure, namely one in which, from the laws of the theory and a state description of the system at a given time, one and only one state description will be deducible for the system at another time. Or in another set of words "to say of a theory that it is deterministic is to say that to any given, initial state description of a system and a given time lapse, the theory coordinates one and only one terminal state description."[2]

If a theory is deterministic the system involved is deterministic with regard to the variables to which the theory refers. Variables and elements have previously been defined. Variables of state are merely those referring to the elements of the system, e.g., the location or momentum of the objects in the solar system. A state description is a statement describing the system at any given time and it is made up of singular statements each of which specifies a value for one of the state

---

[1]Bergman, op. cit., p. 105.

[2]R. Rudner, "The Problem of Functionalism," Second Research Conference, Michigan Department of Mental Health, 1959, Manuscript, p. 18.

variables at that time. If that state description and the laws of the theory make it possible to deduce the state description of the system at another time it is a deterministic theory. A theory which has this characteristic has a certain logical structure but this structure has nothing to do with the certainty of the theory or with the truth value of its propositions. Also, the predictive statements are of an "If . . . then" form and therefore do not demand the future state occur but only say if a certain condition prevails then there will be certain consequences in the system.

There is sometimes confusion regarding the significance of statistical theories in the context of determinism with the occasional expression that if a theory is statistical in nature, i.e., it predicts events on a probability basis, it can't be deterministic. There are two kinds of probability to be reckoned with here. The first is the probability which might be called the extent or degree of confirmation of an explanation of a phenomenon. This probability underlies all theories in science. The second kind of probability refers to the relative frequency of an event in the long run. This is the probability of statistical theories. A theory may be deterministic and statistical just as it may be deterministic and involve probability only in sense of degree of confirmation.[1]

Social theories probably are most commonly of a statistical form. This refers, of course, to the nature of their predictive operation and

---

[1]R. Carnap, "The Two Concepts of Probability," in H. Feigl and May Brodbeck, eds., Reading in the Philosophy of Science (New York: Appleton-Century-Crofts, Inc., 1953), p. 442.

Another problem has been raised by the development of quantum physics the nature of which has led modern physicists to call the principle of determinism into question largely on the basis of Heisenberg's "uncertainty relations." Nagel has thoroughly explored this alleged acausal nature of quantum theory and appears to have satisfactorily demonstrated that there are variables just as central to quantum theory as the uncertainty relations and with regard to which it is a deterministic theory. The Psi-function, referring to the wave-mechanical formulation of the theory is such a characteristic. The reader is referred to the article for the detailed explication of this complex and interesting argument (E. Nagel, The Causal Character of Modern Physical Theory," Feigl and Brodbeck, ibid., pp. 419-437.

not to the statistical methods of verification which have become a familiar hallmark of sophistication in social science. It would appear that by nature of the variables involved in social systems and perhaps because of the unforeseen or unpredictable interference of system parameters the "if . . . then" statements will usually include a statistical factor becoming "if . . . then with a probability of p." This does not rule them out as deterministic theories. Again it should be stated that the probability that a theory is true has nothing to do with whether it is a deterministic theory relative to a specified set of variables. When a theory includes laws which make it possible to deduce a state of the system at any given time from a description of the state of the system at another time it is deterministic and this is seen as a fundamental attempt to social systems theories. (Perhaps it would be more accurate to say "should be" a fundamental attempt.) But this attempt is hampered by another characteristic which may be part of social theories. They may be teleological in nature; that is, they may refer to systems as goal directed, or purposive or having preferred states. In such cases, of the possible end states of the system there is a propensity for the system to select certain one(s) which may be called the goal states. In order to pursue the analysis of systems further it is necessary to consider the significance of this teleological reference of most social system phenomena.[1]

The common way of approaching analysis of teleological theories has been through an attempt to determine whether they are different from non-teleological explanations and therefore are methodologically autonomous. At the simplest level of analysis it has usually been pointed out that where a reference to the future as an explanation for present behavior is offered there is actually a reference to human intention as the causal factor. "I put aside all social activities in order to finish my thesis" is a teleological explanation but it is not the completed thesis in

---

[1]The analysis which follows is heavily indepted to Braithwaite, Nagel and Rudner.

the future which is responsible for the action but rather the present intention of the actor to finish it.

At a somewhat more complex level it has been shown that some teleological explanations do not postulate any purposive behavior of the system but merely specify the functions which certain variables possess and that this statement of function is a statement of the consequences for a teleological system of one of its parts. This statement of consequences is held to be equivalent to a statement of the conditions under which the system persists in its characteristic form. "The function of anxiety in the individual is to prevent conscious recall of disturbing memories," is a teleological statement. The non-teleological equivalent statement is "Unless the individual has anxiety certain disturbing memories are recalled." The statements differ not in factual content but in the focus of attention.[1]

But these types of statements are only a few of the teleological references in the biological and social sciences. Others do not yield to such a simple explanation of equivalence. Systems, commonly attended to in social sciences, exhibit adaptive and regulative activities. The question here revolves around the problem of what constitutes a teleological explanation and the import of this for sociological theories particularly functional theories which it will be shown are a class of teleological explanation.

Teleological explanations are causal statements referring to systems which display a tendency toward certain of all possible end states which the system might achieve. They are often said to be purposive, or goal directed or directively organized systems because of this tendency. The explanation is couched in terms of a future goal as a cause of prior behavior of the system and it is this explanation on the basis of future cause which is considered to give teleological explanations

---

[1]E. Nagel, op. cit., p. 541.

their special nature. A future cause as an explanation has largely been refuted through the device of pointing out that it is actually a condition or state of the system along with certain laws pertaining to the system which determine its state at any other time. In this sense, the state of the system at any time other than the present is not actually influencing the present behavior of that system. Assertions of this kind expose the necessity that the theory involved be deterministic. Here it should be pointed out that a system may be teleological with reference to certain aspects of its behavior and not with regard to others or in other words, when a system is said to be teleological the full statement would be that it is teleological with regard to the explanation of certain of its variables and their interrelationships.

Braithwaite has stated that the fundamental notion in teleological explanation is that of a causal chain.[1] The causal chain refers to the theory or explanation in which the explaining cause is not a preceding event continuous with the event to be explained but a preceding event connected to some other event and so on until the event to be explained is finally reached through a chain of explanatory events. The causal chain is not peculiar to teleological explanations but in theories pertaining to teleological systems where there is active persistence toward a goal its importance lies in the fact that alternative causal chains may be used to arrive at this goal. This property of the system through which it arrives at a particular goal by one of a variety of routes is called "plasticity" in Braithwaite's terms.[2] Plasticity is the distinctive criterion of teleological explanation and may be defined explicitly as a property of the system with respect to a certain goal which eventuates in the attainment of the goal under different circumstances by alternative forms of activity. The essential feature of plasticity of behavior

---

[1]Braithwaite, op. cit., p. 328.

[2]Ibid., p. 329.

is that the goal can be achieved under a variety of circumstances not that it can be attained by a variety of means. In order to pursue this concept a set of definitions will be helpful. Let V be the variancy which is the class of field conditions, F, which uniquely determine those causal chains, C's, which are members of the goal state(s) G of the system. Loosely, the variancy is the range of circumstances under which the system attains the goal.

A system has plasticity when the variancy, V, has more than one member so occurrence of any one of the alternative sets of field conditions, F, is together with the initial state of the system, E, sufficient for the attainment of the goal, G. To say that a system will attain G is to say that V is large enough to contain every set of field conditions likely to occur. This is equivalent to the statement that V will contain F.

The import of this explication is in relation to the way in which knowledge of the variancy is arrived at. Knowledge of V can come from deduction from knowledge of relevant causal laws for the system and this knowledge can be used in two ways: (1) in experimental situations where it is possible to control the situation so that V is small and F is made smaller yet. (2) Where F is large but V is arranged to be larger yet as in the case when a system is built to withstand a wide range of conditions or when there are self regulating devices built into the system to ensure it will accommodate to a wide range of conditions. Any number of machines will serve as examples of this kind of situation but most of them are relatively unimportant in so far as social systems are concerned. There may be a not too distant time when a teleological theory pertaining to small groups might be used in conjunction with a laboratory situation and in which the variancy and field conditions could be controlled to permit prediction. However, it is not really useful to apply teleological explanation to these situations. It is unnecessary because that causal chain which will occur has been controlled by the experimentor or he

has been able to build a system with a variance great enough to include probable field conditions and an ordinary causal explanation will suffice.

A second way in which knowledge of the variancy is obtained is through inference from knowledge of the field conditions under which the system or systems like it have achieved the goal in the past. In this instance V is inferred from knowledge of F where similar teleological behavior has occurred. There is no ability on the part of the investigator to control the variancy or field conditions. Here teleological explanation is useful and the greater the plasticity of the system the more useful this explanation will be. The teleological argument requires inference at two stages, first for inference of the variance and second that the set of relevant conditions that will in fact occur in the future will fall within V. For sociology this is of course a deceptively simple definition of teleological explanation for it leads to the impression that all that needs be done is to inspect similar systems, determine the field conditions under which certain goals have been achieved by one or more of these systems, enlarge on this set of conditions to include others which might be expected to occur and then predict that one set of these conditions will in fact occur. This is a considerable program to undertake. Even the decision as to similarity of systems is not a simple task. But it is submitted that only if this program can be undertaken, no matter how tentatively and slowly it must be done, can social systems theories which serve to describe, explain and predict, be achieved.

Clearly this exploration of teleological explanation has been oversimplified and requires further detailed analysis. It is also necessary to determine the relationship between teleological explanation and functional explanation and between teleological systems and functional systems if much of sociology's knowledge of system behavior is to be brought into focus. The discussion so far has applied to systems with a tendency to achieve a certain end state out of the alternatives possible

and these end states have been referred to as goals. There is also the teleological explanation which has reference to systems which are in the preferred or goal state and display a tendency to remain in this condition. Nagel, using the term directively organized systems, states that if a system, S is directively organized, the persistence of property G is in a certain sense independent of the variations (up to a point) in any one of the causally relevant parts of S. For although it is the state of these parts which by hypothesis determines the occurrence of G, an altered state in any of them may be compensated by altered states in the other parts of S so as to preserve S in its G State.[1] For the moment this differentiation of persistence in a goal state from persistence toward a goal state is simply pointed out. However, it is an important distinction which will be considered in detail later both in relation to teleological explanation in general and to the nature of persistence and change in social systems.

The discussion has considered the specification of the general meaning of goal directed systems but it has not come to grips with the problem of determining what end state is a G state. Rudner has provided a discussion of the way in which the goal(s) of a system can be determined.[2] The comments which follow are developed out of his paper. It has been indicated that a system may achieve its goal from a number of different initial states, i.e., it may arrive at a certain end-state E (or E_1, E_2, . . .) from various initial state descriptions. E(or E_1, E_2, . . .) if it is a preferred state is a goal state, G. Determining the number of different initial state descriptions which yield a given E and calling this the s-number, a simple explanation of the statement that a system displays a preferredness for E is to say that E is that end-state whose s-number is maximal. Then to say a system S displays a preference for E_1 over E_2

---

[1]E. Nagel, op. cit., p. 546.

[2]R. Rudner, op. cit., p. 20 ff.

might simply assert that the s-number of E_1 is greater than the s-number of E_2 and E_1 is then the goal state G.[1] In order to determine the s-number it is, of course, necessary to have a theory providing the laws by which variables may be combined or interact in the system. The s-number is the number of initial states which yield a given E state to be called the goal G. The variance it will be recalled, is the range of circumstances under which the G is arrived at. These are two aspects of plasticity of teleological systems although Braithwaite would stress the latter as the important point in so far as his conception of plasticity is concerned. It appears that we now have some understanding of the way to arrive at the variance of teleological systems and to determine which of the possible end states is the probable one, i.e., the G-state.

However, it turns out as Rudner points out that the s-number, if it is to explain preferredness, demands the condition that there be equal probability for every initial state description to occur. If there were equal probability of occurrence for every initial state and if a given E state were arrived at from a greater number of these initial states than was the case for other E states then this given E state would be the G-state of the system. It is not likely that the equiprobability criterion is met by many teleological systems so it is necessary to find an explication of teleological explanation which accounts for the tendency toward a G-state which is not that state with the greatest s-number.[2]

In this instance one teleological explanation consists of specifying the variables of the system and determining that a change in one variable

---

[1]The reader is referred to Rudner, for a detailed explanation through the use of a set of examples of a system with three elements which may vary in three ranges and the end states which all combinations of these variations could yield (F. Rudner, op. cit., pp. 21-22).

[2]This requires the introduction of the concept of probability but the concept will be oversimplified for this discussion since in so far as it is relevant to the discussion an oversimplification will suffice. It is the second type of probability referred to earlier in chapter; that is relative frequency in the long run rather than degree of confirmation.

from time t to time t_1 will be accompanied by probability p that the other variables will take on new values so that at time t_1 the sum of all the variables will equal their sum at time t. The sum of the variables indicates the state of the system and it will be the same at both t and t_1. This is a statement of the preferredness of the system for a G-state in terms of the probability of the system to maintain this state. This preferredness may be called the degree of goal directedness of the system.

The degree to which a system is directed toward attaining a G-state may be outlined as follows. Taking a system in which the values of the state variables at time t do not equal the G-state, and given that one of the variables takes on a certain value there is the probability p that the other variables will take on values such that they with the first variable value, will equal the G-state at time t_1.

These statements have indicated the basic nature of teleological explanation in reference to teleological systems. The functional explanation is a sub-class or a special case of the teleological explanation. In the functional system there is a chain of states which occur in order to arrive at or maintain a G.[1] The laws of the theory specify that a property of some element of the system is either a sufficient condition or a correlated condition with the occurrence of an end-state which is, in turn, a necessary or correlated condition for the occurrence of the goal state of the system.[2]

Rudner offers an analysis of a Malinowski statement that the element "ritual wailing" has the property "expressing group loss" which is

---

[1]The causal chain which Braithwaite refers to appears again but here its significance is not in the alternative causal chains permissible in arriving at a G-state but in the characteristic of a series of explanatory events as a cause.

[2]The brevity of this statement will leave many questions which are best answered by reference to Nagel, "A Formalization of Functionalism," in Logic Without Metaphysics (Glencoe, Ill.: Free Press, 1957), and in Rudner, op. cit.

construed as a sufficient condition or a correlated condition with the occurrence of an end-state of "group cohesion and solidarity" which is in turn, a necessary or correlated condition with the occurrence of a total state of the system, in this case "survival."[1] Blau provides many additional examples in his study of two government agencies.[2] For one, he mentions that in one agency there is a Sunshine Club, an arrangement by which the usual gift giving practices of an office are formalized. "The Sunshine Club divested presents of this [personal] significance and transformed them into symbols of group membership as such, independent of the particular friendship ties an agent may have established. Only this formalized giving of presents served social cohesion by reaffirming any absentee's continued integration in the entire work group."[3] Thus giving gifts (element), provides symbols of group membership (property) reaffirming absentee's continued integration in group (end state) which serves social cohesion (goal state).

These examples though highly simplified can be related to the foregoing development of the criteria for teleological systems. It appears beyond doubt that Blau did not intend that the particular governmental agency he referred to would not continue to exist had there been no Sunshine Club. In fact he implies that the Sunshine Club was neither a necessary nor a sufficient reason for the continued existence of the organization and gives a number of additional elements which are seen as "functional" for the system but which again are not considered as necessary or sufficient conditions for its survival where survival is construed as independent of such characteristics as a cohesive group. These examplify the point that in a system which has plasticity there are

---

[1]Rudner, op. cit., p. 44 ff.

[2]P. Blau, The Dynamics of Bureaucracy (Chicago: University of Chicago Press, 1955), 269 pp.

[3]Ibid., p. 135.

alternative means for arriving at goal states but it is doubtless correct to conclude that the alternative means are less significant than the fact that the system may arrive at its goal under a variety of circumstances.[1] The functionalist argument generally suggests that there exists for a system a set of items or a class of items which are sufficient to the continued functioning of the system.[2] Thus one of a variety of means for maintaining or achieving a G-state is present. Perhaps this is a fundamental stress of functional explanations which is somewhat over-emphasized. Such statements do not enable the prediction that the system will function at some future time. Would it not be more appropriate to consider the ranges of circumstances under which a system can maintain or arrive at a G? This entails determining what the goal state is and the field conditions which can be expected to occur. These field conditions then must be related to the range of values the variables of the system can take on. The values of the variables need not be in quantified terms. Variables may refer to sacred or profane, power or non-power etc. Oblique reference to this point is provided by Hempel's statement ". . . functionalist arguments . . . clearly seem to presuppose a general law to the effect that, within certain limits of tolerance or adaptability, a system of the kind under analysis will--either invariably or with high probability--satisfy, by developing appropriate traits, the various functional requirements (necessary conditions for its continued adequate operation) that may arise from changes in its internal state or in its

---

[1]The principle of equifinality advanced by Bertalanffy, and which he uses to state the principle that the system may reach the same final state from different initial conditions and in different ways is equivalent to the explications of teleological systems and of plasticity in particular. Bertalanffy singles out this phenomenon as pertaining to open systems only and explains the teleological behavior of closed systems on the basis of servo-mechanisms.

[2]Merton has been emphatic in pointing out the need for a postulate of functional alternatives. ". . . we must set forth a major theorem of functional analysis: just as the same item may have multiple functions, so may the same function be diversely fulfilled by alternative items." (Merton, Social Theory and Social Structure, op. cit., p. 32).

environment."[1] Hempel calls this argument a hypothesis of "self-regulation." It is not very clear whether appropriate traits are new elements or changes in the condition of elements already present. But this brings out another characteristic of open systems, i.e., new elements can be taken into the system. For example, in a bureaurocratic organization a staff position with responsibility for analysis of performance data might be added if there were either external or internal pressure to determine the level of performance of personnel in field stations. It seems that this characteristic makes it even less fruitful to attend to means for achieving or maintaining the goal state and more important to seek knowledge of the set of field conditions or parameter values under which adaptation may occur and the range of variation possible to system variables. Obviously the Goal must be known (or at least specified for test) if this procedure is to be possible.

Briefly the preceding paragraphs have attempted to show that there are three aspects which characterize the nature of teleological systems. These systems reach goal states (1) from different initial states, (2) by a variety of means, (3) under a variety of conditions. It was indicated that (1) and (3) are the significant characteristics for attention in analysis of these systems.

Among the many methodologies of sociology used in analysis of social organizations as they are construed here, one which appears close to the teleological system analysis is that of the "means end schema." Certain comparisons may be made between the two. Means-end schemas in sociology have been discussed by a number of theorists among whom Weber and Znaniecki may be mentioned as presenting apparently oppositional views. Weber in his classification of ideal types of social action distinguished four types. One of these Zweckrationalität refers to action rationally oriented to the maximum

---

[1]C. Hempel, "The Logic of Functional Analysis," op. cit., p. 290.

attainment of a plurality of ends weighed against one another and in consideration of not only efficiency of attainment but cost. Wertrationalität is a means of action in which a given value is put into practice regardless of cost. Traditional action refers to adherance to established patterns without regard to efficiency or effectiveness. Affectual action refers to action motivated in terms of feeling and sentiment without concern for any of the factors involved in the other three. The last two categories are residual and are not clearly defined. There appears to be little, if any, consideration for the system as it operates, with the dependence and interaction of sub-systems and the accommodation of one sub-system to the actions of another. The frame of reference appears to be largely in terms of the rationality of the action with the two non-rational categories left as ill defined, alternative possibilities.[1]

Znaniecki, on the other hand condemns this approach to social action when he asserts, in effect, that there is a trial and error attempt at social control. He sees a demand for rational control of social evolution resulting from increasing rapidity of evolution. This demand results in an "act of will" to control and there are occasions when the means for control are actually effective. However, he argues that the act of causation is not known and the success if accidental and dependent upon the stability of general conditions. When these conditions are changed the only recourse is further guesswork until another means is found.[2]

The teleological system framework is intertwined with these representative theorists in several ways. First, of course, it must be

---

[1]Talcott Parsons, "Max Weber's Sociological Analysis of Capitalism and Modern Institutions," in An Introduction to the History of Sociology, ed. Harry F. Barnes (Chicago: University of Chicago Press, 1948).

[2]W. I. Thomas and Florian Znaniecki, "Ordering and Forbidding," in Sociological Theory, eds. E. Borgatta and H. Meyer (New York: Alfred A. Knopf, 1956).

again pointed out that whether or not systems are, in fact, teleological is a matter of empirical test and the purpose here is merely to develop a set of criteria for assiting in establishing a framework for such testing. Here the system model is offered as a more precise formulation which enables such test for the theorist. Both precision and a framework for analysis of the interaction of sub-systems and of system with environment are provided by the model. Znaniecki's objections actually provide one more reason for the employment of the teleological system analysis. His assertion that the successful act of causation (or the successful means) is accident is a statement that, in the last analysis, the rationality underlying attempts at social control (or achievement of goals) is largely trial and error. The cognitive perception of the reasons for success or the choice of means may be a form of primitive logic or at least he so implies when he compares such acts to the magic of primitive peoples. It has been held, and will be further elaborated here, that the actions of systems in goal achievement are not the focus of attention of system analysis and in fact such attention is relatively unfruitful because the acts are likely to be trial and error and the effective means under one set of conditions may never again be effective since conditions change. Such conceptions underly Braithwaites comments that the significant aspect of teleological systems is that they begin from different initial conditions and arrive at the same final state not that they do so through a variety of means. This is also inherent in Ashby's contention that systems adapt by trial and error and the particular means of adaptation are largely irrelevant.

Ashby provides a series of conceptions which provide additional help in the present approach to functional systems.[1] His analysis of the constancy of variables rounds out the means for analyzing systems in terms of stability and change. There are four types of constancy which

---

[1]Ashby, op. cit., p. 80 ff.

may be displayed by variables of a system. Constancy refers to a period during which a variable shows no change in value.

The full-function has no finite interval of constancy; the part-function has finite intervals of change and finite intervals of constancy; the step-function has finite intervals of constancy separated by instantaneous jumps and the null-function shows no change over the period of observation.

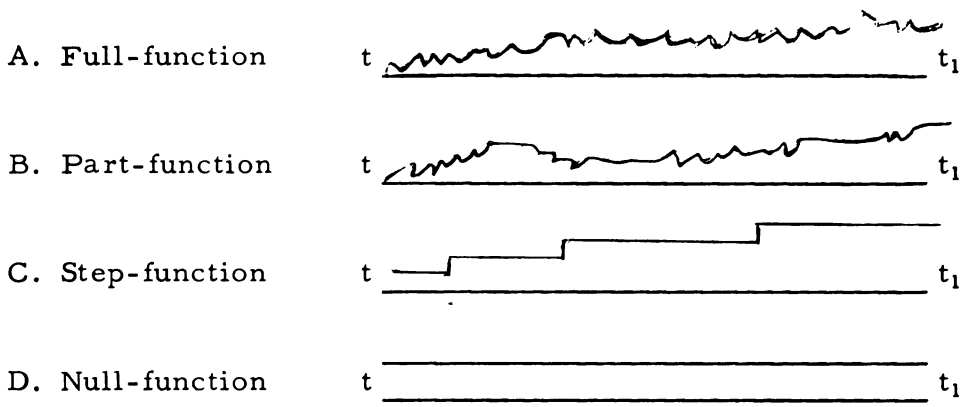


Figure 1. Types of variables in Teleological Systems.

With regard to step-functions, all the states of the system can be divided into those whose occurrence leads to a change in the step-function's value and those whose occurrence does not lead to such a change. Those states which do lead to a change in a step-function's value are critical states. Should a critical state occur in a system with regard to a step-function there would be a change in the step-function which is tantamount to a readjustment of the system to accommodate to the change whether it was stimulated by a change in a system variable or parameter; that is by an internal change or through a change in field conditions. A system which breaks down will usually show a step-function change--an instantaneous jump in behavior, even though step-functions may not be a

typical behavior of the system's variables when it is functioning adequately. Each time a system variable which is a step-function reaches a critical state there will be a change in behavior of the system. If the system is to come to a stable condition it will be necessary that the variables not reach critical states. If the system is goal directed or teleological, the process of change once initiated by internal or environmental variable changes, will be selective toward the G-state of the system. This principle of selection applies in an open system where there is an interaction between the variables of the system and its parameters. A closed system would have stability based on interaction of internal variables but in isolation from the environment. The fact that there is adaptation of system behavior which includes reactions to environmental variables would incline toward acceptance of the notion that the open system with this adjustive action is ultrastable since achievement of stability requires a somewhat higher order of adjustment.

Now the classification of functions into full-, part-, and step- outlines varieties of behavior which may be exhibited by the variables of a system. In organizations of interest to sociology there may be the instantaneous jumps in behavior which characterize step-functions especially when there is system breakdown perhaps because of some great and sudden alteration in the system's field. Generally the main variables of the system would be expected to be full- and part- as well as step-functions.[1] Certain points about these various behaviors need to be clarified. A variable which is a part function i.e., has intervals of change and of constancy, need not return to the same value it had prior to an interval of change. The full function variable always is in a state of change. The step-function variable changes instantaneously when it reaches a critical state. In other words, all of these types of variables

---

[1]Means for determining main variables are discussed in Chapter V, pages 85-86.

exhibit change although they are a part of a stable system. There is an important relationship between constancy and change which is significant for sociology confronted with the problem of change in social systems at the same time as their stability must be recognized. In short social systems persist and only if this is the case does it make sense to talk about a given system except in an historical sense. But they do not persist in an absolute static arrangement. They experience change. The concepts of part-, full- and step-functions as type of variable change in systems combined with the analysis of teleological systems clarifies the nature of this change which may be conceptualized as adaptation. The open system with a preferred state will adapt to shifts in parameter values by changes in internal variables which are adaptations to new stimuli which without variable adjustment would alter the interrelationship of these variables and take the system out of its G-state. When a G has not been reached there will be selection of those adaptive behaviors which tend to put the system into its G-state. System change then is adaptive behavior and it follows that the more stable the system the more likely it is to adapt successfully, i.e., maintain or achieve a G-state.

Stability means that the variables alter together or that for a change in one there is a change in other(s) which maintains the sum of all of them at a certain G or which shifts the total system toward the G-state. In this sense, there is change in a system but this very change is a part of the process of adaptation in order to persist--to be stable.

It is in regard to this process that functional alternatives can be brought into the analysis. Certain elements or items in the system are necessary to maintain it in a given goal state. Changes in state may require a change in the condition of these elements or they may be rejected and replaced by other elements of the same type already a part of the system but previously less significant for it or they may be

replaced by new elements introduced into the system.[1] This is the significance of functional alternatives. By a sort of trial and error approach the system will go through a process of adaptive behaviors which accept and reject new elements or alterations in the values of old elements until one is selected which permits the system to be in its goal state. The system is thereby constantly changing state. It is perhaps possible to determine the nature of these alternative elements but it seems more important to determine the conditions under which this change will occur than it is to determine the specific items which could serve as functional alternatives.[2]

Using Blau's example of the Sunshine Club again it may be reformulated in this manner. The governmental agency was an adequately functioning unit with an integrated membership. A member became ill. Personal friends took up an office collection to send him flowers. This act served as a social symbol of group membership which in turn reinforced group cohesion. The agency continued to function with him as an integrated member of the group upon his return and symbolized that this was the case for any member who might be ill. Now this stable state (G) was interrupted by the failure of some members to get flowers because of the haphazard manner in which the act was initiated and carried out or for other troublesome problems such as the value of the contribution varying at different times. This threatened the group cohesion so the group formed the Sunshine Club which, though it depersonalized the whole

---

[1]Further exploration of this proposition might also be useful in understanding "survivals" which may be elements encompassed in a system but not central to its operation in the present state.

[2]It is to be understood that this analysis refers to statements about the system model. Whether or not a given system actually does adapt in the described manner is always a matter for empirical test. This point should be kept in mind for any of the statements about systems as models.

action, insured that the social symbol of group membership and the resultant group cohesion occurred. This demonstrated adaptive behavior of the system where a different method was used or a change was initiated in order for the system to persist. A goal state was maintained on the basis of the first trial in so far as we know from Blau's data. But it might have happened that the director of the agency decided to visit all group members when they became ill and thus provide the symbol of group membership. The functional item or element would then be the visit not the giving of gifts. It so happened that giving gifts in a formalized fashion was hit upon by the system. What item worked out is not important. The point is that there was system adaptation in order to maintain a Goal state. Focusing attention on the particular item which was used serves only to keep the observer in the dilemma of trying to specify the infinity of possible elements which could serve a functional purpose or at least specifying some set of classes of such items. This focus of attention leads to such statements as "If the system functions at a given time one of a class of necessary functional items is present," which is a weak statement indeed and predictive statements of any import seem impossible to supply.

An example of an organization achieving a G-state might be constructed as follows. Take an agency charged with the enforcement of health codes but which is not adequately functioning in that it has not achieved this goal. There is a high membership loss from the staff and this turnover leads to constant fluctuation in the behavior of the system since there are wide variations in the performance of staff functions, not only among the different positions but also over time for a given position filled by a string of incumbents. If the range of other variables in the system, such as handling of correspondence, public relations, failure to perform enforcement which is visible to the public, is too great the system will break down. That is the variables reach critical states and get outside the range of system stability entirely. Assume for the moment that they do not get beyond the capacity of the system to continue

to adapt through changes in behavior. The public relations are good enough to get by, health codes are not enforced adequately but, as yet, no epidemics of disease have broken out although responsible executives are convinced that the agency is not fulfilling its goal and adjustive measures will have to be taken. Say a program of higher wages, better definition of work assignments and weekly staff meetings for exchange of opinion and suggestion is initiated. Following this action, and at a decent interval, the agency becomes a cohesive system in which the organizational goal of enforcing health codes has improved to the point that there are no flagrant lapses in their practice and there is no real danger of disease outbreak in so far as these health codes can affect such a possibility. This is an adaptation of a system to achieve a goal state (adequate enforcement of health codes) through the alteration of the values of a certain variable in the system, namely group cohesion which is brought about by lowering turnover and raising moral. This is the chain of causal events typical of the functional system.

These examples may serve to indicate certain methodological demands of functional analysis which need to be met in the development of organizational theory. It should be clear that we are treating functional analysis as analysis of teleological systems. A series of methodological steps can now be stated.

1. Determination that the system in question is teleological--that it does have a G-state (and if it is also a functional system).
2. Determination of the goal state.
3. Statement of the different conditions or circumstances under which the goal state can be achieved recognizing the causal chain or "intervening end states" which are part of functional system behavior in moving to a G-state or in maintaining it.
4. Specification of the ranges within which the system variables can vary without system collapse.

Certain steps are implied and not stated above which include the initial selection of the "system" and the elements to be investigated.

The analysis thus far has considered organizations as "wholes" with interdependent parts. But in sociology, as in other substantive areas, many systems are made up of sub-systems which have some degree of independence.[1] The problem is to determine the way in which a system encompasses sub-systems with partial, fluctuating and possibly temporary independencies without losing its essential wholeness. The notion of essential wholeness is important for to assume a set of sub-systems are completely independent from the whole is to reduce the notion of systemness at the more inclusive level to a dubious concept. There must be some interrelatedness of the sub-systems at least during some time during which the supra-system is moving toward or maintaining a G-state. This is to say that the end-state of a sub-system must be related to the G-state of the whole and the sub-system must interact at some time with some other sub-system(s). If this were not the case it is not a necessary part of the whole and would be ruled out of the system at the time the variables were tested for inclusion or exclusion. Sets of variables which failed to meet this criterion might well be among the parameters of the supra-system.

Sub-systems may react to stimuli from the environment by adaptive behavior in the course of seeking or maintaining a g-state without affecting the remaining sub-systems in the whole. It is to be noted that this lack of effect on other sub-systems is not equivalent to saying there is no relationship to the G-state of the supra-system. Perhaps unfortunately, in terms of complexity, it is also possible that sub-systems in the course of moving toward or maintaining g-states may affect the state of other sub-systems. There may be an incompatible relationship between the g-states of two or more sub-systems of the whole or the g-state of one sub-system may be dependent upon the variations of another sub-system.

---

[1]The discussion which follows is developed in part from Ashby, op. cit., Chapters 12-18.

These two alternative sub-system relationships can be illustrated by examples. In the first instance where sub-system behavior is mutually independent, an example may be drawn from physiology. A change in the calcium balance of the organ system initiates an attempt of that sub-system to maintain a homeostatic balance and there is no action of other sub-systems or of the supra-system unless the g-state of the organ system is lost. Where the variables of the organ system move within the range of their permissible variation in reference to a step-function change in the calcium balance and adjustment of the calcium balance results there will be no action of the supra-system. But should one or more of the variables of the organ system move outside this permissible range of its g-state there will be excitation of other sub-systems in the whole as the whole strives to maintain its G-state. The organ system is an independent sub-system up to a point of variation which becomes critical for its g-state and thereby, for the organism.

An industrial organization will serve as an example of a supra-system wherein there may be incompatibility of the sub-systems in so far as their g-states are concerned. Take an automobile manufacturing industry. The sales, engineering and accounting departments are three of the sub-systems involved. Engineering may have as its g-state design of the most efficient, durable and powerful auto possible within the limitations of available knowledge. Sales has as its g-state the selling of the greatest possible number of cars and therefore may demand machines which are not durable and which may have a number of "gimics" which lessen efficiency, and which are less powerful in order that prices be kept in a more accessible range relative to consumer purchasing power. Accounting will have a g-state which depends on production of a car with the widest possible range between cost and selling price which may lead to conflict with the g-states of both engineering and sales since it may wish to eliminate both high standards of product which are part of the g-state of engineering and costs of the chromium frills which are seen as

competitive necessities by the sales department. These goals are incompatible in so far as the sub-systems are concerned but it is imperative to note that the goal of the manufacturing organization as a whole includes building a reasonable product and selling it at the greatest profit. There is a "long run" profit involved. The G-state of the supra-system requires the balancing of the incompatible g-states of these three sub-systems. The system as a whole then, may at different times disrupt the g-state of one or more of its sub-systems.

Returning to the differentiation of action of variables in terms of full-, part-, and step-functions it could be said that internal pressures from the system act to move the variables of a given sub-system to a critical state and a step-function change occurs which results in removal of the sub-system from its g-state. Variables of the separate sub-systems might also change as part-functions where there is an interval of change followed by an interval of constancy. The intervals of constancy can occur while the sub-system is in its g-state or during a period in which it can not move to a g-state because of the state of a second sub-system upon which it is dependent. In this sense, the part-function might be called a "waiting game" but the import of the statement is that the possibility for a supra-system to include sub-systems with incompatible g-states may depend upon part-function behavior of the variables of the sub-systems.[1]

It is crucial to note here that while there may be <u>independent</u> adjustment or goal seeking behavior on the part of individual sub-systems there

---

[1]Time is something of a problem here. A variable which shows no change over a period of observation is by definition a null-function. But should a part-function be observed at the appropriate interval it would be seen as a null-function. With more extended observation it would be seen to be a part-function. For our purposes the interval of constancy is equivalent to a null-function but because it is expected that most sociological variables are part- rather than null-functions and because it is assumed that some change will occur in the sub-system at some time it is preferred to simplify the discussion by omitting reference to null-functions.

remains interrelatedness of these sub-systems within the supra-system. The independent action of a sub-system does affect the whole and it may affect other sub-systems which do not necessarily affect it in return. Obviously it is necessary to provide a definition of independence. If there are two sub-systems A and B and an action of A is followed by an action of B but an action of B is not followed by an action of A then A is independent of B but B is not independent of A. A sub-system is independent if it is not affected by action of any other sub-system in the whole even though its own action may affect other sub-systems. It is also the case that if B is dependent on A and A is dependent on C then B is dependent on C. In this case a change in C will be followed by a change in B.

In a supra-system where the g-state of B is to be maintained it is necessary that the variables of sub-systems A and C be part-functions. For A to remain in its G-state there must be no change in C but C will remain in its g- state regardless of A and B changes. Conversely, a change in either A or C will be followed by a change in B which may result in its losing its g-state and so forth for the set. It is obvious that for a supra-system to maintain or achieve a G-state it is necessary that sub-system variables have periods of constancy and periods of change.

Another way of stating the above remarks is that interdependent sub-systems adapt to each other in the process of achieving or maintaining g-states whether this be in a one-one relationship or through a chain of dependency. Sub-systems which are independent need not adapt but those sub-systems dependent upon them will change if they change. The net result for the supra-system will be co-ordination among sub-systems which tends to keep the whole within the range of variation appropriate to its G-state. This is a restatement of the principle stated earlier that in a goal directed system the process of change, once initiated by internal or environmental variable changes, will be selective toward the G-state of the system.

With this overriding principle in mind it is possible to indicate one additional consideration useful for this analysis of system models. The co-ordination of sub-systems in the movement of a supra-system to its G-state or in striving to maintain it indicates that for different stimuli there may be different combinations of the interactions of sub-systems. On one occasion sub-systems may be combined in one way or series of ways until a G-state is achieved and on other occasions there may be different combinations. This may be a trial and error action and that trial which results in success will end the adaptation or change period. The next time a like stimulus occurs there will be initiation of system behavior based on the prior successful combination of sub-system interactions but, especially with systems exposed to the variety of conditions characteristic of social organizations, there is likely to be some change in the environment of the system and the formerly successful method may not work.[1] A new combination of sub-system interactions is likely to eventuate. For this reason attention to the action of the sub-systems with an attempt to predict their interrelations may be fruitless. It is the range of circumstances under which teleological systems are able to achieve or maintain a G-state which is the focus of attention, not the means by which this is carried on. The range of change which is permissible to sub- and supra-system and the probability that these ranges will not be exceeded is the major focus.

This discussion of interrelated and independent sub-systems within the whole has extended the analysis of teleological system models into an area which appears to be of primary significance to sociology which is confronted with organizations the very definition of which includes a

---

[1]Whether the social organization actually does "learn" from its trial and error adjustments and whether it can act on this learning on a second occasion is open to empirical test but it is assumed here that it is safe to proceed as if it were proved true since its likelihood is so apparent.

set of sub-units with certain prescribed functions. It enables addition of a final entry in the list of methodological steps given above. This is step 5: Designation of the sub-systems within the larger system and determination of their dependence or independence with regard to the supra-system.

An additional consideration may be added here. Sociologists along with other scientists have made a distinction between the structure and process of systems. Parsons, for example, conceives of four levels of structural organization in a complex society and within these levels are structural units. Systems mediate the relations among structural units and this mediation is a dynamic process. ". . . it is in general not wise to attempt to undertake complicated analyses of dynamic process without adequately clarifying the structural reference points that describe the system in which the process takes place and its situation."[1]

In this analysis the elements or sub-systems, depending on the complexity of the system involved, are the structure of the system. In a bureaurocratic organization the sub-systems are a part of the system structure. Within sub-systems the elements are the structural aspects of the sub-systems. The adaptation of the system or of sub-systems or changes in the relavant properties of elements are the processes of the system. Thus, movement of a system toward a G-state or adjustments of variables of the system in attempts to maintain a G-state represent processes.

Appendix A gives an outline summarizing the focalizing which has resulted from the analysis to this point.

---

[1]Merton, et al. Sociology Today, op. cit., p. 4.

CHAPTER V

IMPLICATIONS OF SYSTEM CRITERIA FOR A SYSTEMS THEORY IN SOCIOLOGY

The content of this chapter will be devoted to a statement summarizing and exploring the significance of the major concepts embodied in Gouldner's analysis of functional theory in Sociology in terms of the systems criteria developed just previously. It has been demonstrated that functional systems are a sub-class of teleological systems and it is to this sub-class that our attention turns in the remainder of the thesis.

Before attempting to determine the relationship between Gouldner's statement and the system criteria stated in the prior chapter it is only proper that some recognition be given to Gouldner's claims for his discussion. In brief, this is the justification for the choice of his work and the demonstration that no violence is done through assuming it purports to do something which in fact it does not attempt. There are three primary reasons why his work was chosen as a statement of organizational theory. First, he has provided a concise statement of his conclusions in his article "Reciprocity and Autonomy in Functional Theory."[1] It is a recent and articulated theory. Second, he has elaborated it in another recent article, "Organizational Analysis," which explicitly puts his commentary in an organizational framework.[2] Third, his empirical work has been with bureaucratic organizations and his examples are usually from an organizational perspective.[3]

---

[1]Gouldner, "Reciprocity and Autonomy in Functional theory," op. cit.

[2]Gouldner, "Organizational Analysis," in Sociology Today, R. Merton, L. Brown, L. Cottrell, eds., (New York: Basic Books, 1959).

[3]See for example, Patterns of Industrial Bureaucracy, (Free Press, 1954), and Wildcat Strike (Antioch Press, 1954).

These reasons are adequate enough for the choice. But does Gouldner claim to have provided a complete or rounded out theory? The answer would seem to be no. He clearly specifies he is talking about theory in the title to the first mentioned article but at the same time the title implies he is considering only certain aspects of it, namely, reciprocity and autonomy. He does indicate the route he intends to follow when he remarks he is going "to make explicit the most generalized dimensions in terms of which systems, formally construed, may vary and then to stipulate the conjunction of formal system dimensions which are to be applied to social behavior."[1] This appears to be a rather comprehensive undertaking but he indicates further that the two most important aspects of system for the sociologist, are interdependence of a number of parts and the problem of the equilibrium of these parts. He further specifies that he intends to attend to the interdependence of parts, "leaving the equilibrium problem for later analysis."[2]

His article on organizational analysis is intended to consider present sociological knowledge and thought on this subject--or so it may be presumed from the purpose of the volume in which it is included.[3] He intends in this paper to clarify some of the advantages and limitations of what he calls the natural-system model and the rational model of organizational analysis, and to discuss certain organizational problems he believes most adequately handled by a synthesis of these two models. The distinction need not occupy us here but the synthesis, it may be pointed out, includes a commentary on organizational tensions, functional autonomy and reciprocity, all of which are integral parts of his more formal statement of functional theory.

---

[1]Gouldner, "Reciprocity and Autonomy in Functional Systems," op. cit., p. 242.

[2]Ibid.

[3]Sociology Today, op. cit.

These considerations then, are the justification for the theory selected. The purpose here is not a critique of Gouldner but an assessment of his approach in the light of criteria for teleological system models already stated with the expectation that such an assessment may advance formal thought about system theories. It should be stated again that this is a methodological approach, not an attempt to develop theory per se. The purpose here is to demonstrate empirically the usefulness of the system model developed in Chapter IV in application to a theory of bureaurocratic organization. In the nature of the case we may push Gouldner further than he intended to go but it should be recalled that only because he has provided a formal statement of the kind under analysis was it possible to make this empirical test at all. His attempt to state his formulations precisely makes it possible to test the system criteria as an analytical device.

One further distinction should be made. In the major statement of his functional theory Gouldner refers to social systems without restriction to organizations as they have been defined in this thesis. In his chapter on organizational analysis on the other hand, he refers to organizations without explicit definition but that he intends to discuss bureaucratically arranged social groups is clear from the following opening paragraph:

> For the past several decades, various commentators have viewed with increasing alarm the growth of large-scale organizations, the impending bureaucratization of the world, and the rise of the 'organization man.' Whether for good or for evil, there is little doubt that the spread of the complex, rational organization is one of the characteristics of modern society, distinguishing it from earlier feudal forms.[1]

It should be recalled that this thesis is concerned with a teleological system model for organizations and not a general model applicable to all systems which may be studied by the sociologist. Bureaucracy's are teleological by design.

---

[1]Ibid., p. 400.

It will be necessary to consider Gouldner's thesis at some length in order to make a formal analysis of its relationship to the system criteria.

According to Gouldner, "Functionalism is nothing if it is not the analysis of social patterns as parts of larger systems of behavior and belief. Ultimately, therefore, an understanding of functionalism in sociology requires an understanding of the resources of the concept of 'system.'"[1]

There are certain concepts within this system framework which hold Gouldner's attention and thus become the focus of our comparison of his system analysis and the system criteria presented earlier. These are: Identification of system parts, functional reciprocity and functional autonomy.

Selection of System Parts

The selection of system parts resolves into what elements shall be considered a system and how the decision to include them shall be made. Gouldner contrasts Parsons who is said to attempt to analyze total social systems in an attempt to identify their constituent elements and relationships, with Merton who attempts to select elements of a system on the basis of empirical determination.[2] It is clear that he prefers the Mertonian strategy. He sees this as a cumulative process through which a battery of explanatory variables will be sifted out by empirical observation and that in this process the interrelations of the variables will be established. It is worth pursuing this point further here since there appears to be some difference in Gouldner's conceptualization of system and that presented here and this difference is important

---

[1]Gouldner, "Reciprocity and Autonomy in Functional Systems," op. cit., p. 241.

[2]Gouldner points out Merton's limited reference to "systems" as such and his exclusion of systems as objects of formal analysis. Ibid., p. 244.

in later comparisons. At this point in his essay Gouldner seems to impute a reality to systems which, as he progresses, is highly tinged with anthropomorphism.[1] But anthropomorphism aside, the problem here is whether or not Gouldner is inclined to the position that systems are empirically establishable as separate and distinct wholes within which, at least in principle, all interacting variables can be specified. On the one hand he unequivocally states that inclusion or exclusion of elements in the social system is not susceptible to "purely theoretical resolution."[2] "Theoretical resolutions" seems to mean an armchair construction which may not be subject to test or if it is the test is simply not made. At the same time he finds that "problematic patterns" can only be partially explained on an empirical basis because with only a partial knowledge of the constituent elements of the social system, which is all that can be obtained with the empirical accumulation technique, it would not be possible to relate these patterns to the system as a whole.[3] He then rules out this objection on the grounds that it is the case for any pattern of social behavior since social systems are open and partial. Finally, Gouldner concludes that a priori selection of

---

[1]This question of "reality" has, of course, broader implications for science in general. The literature abounds with references to the scientist's penchant to impose a pattern which he calls reality upon the phenomenon he studies. For the purposes of science it appears that the success of these patterns in providing explanation and prediction is the criterion against which they should be judged rather than the extent to which they can be found to be creations of the human mind.

[2]It must be recognized that although there is a degree of chiding Gouldner for his anthropomorphism it also occurs in these comments. Where this is the case it is an ellipses for longer circumlouctions--which could be made but would be intollerable if made each time. An effort is always made to refrain from extending such references beyond the short form for expressions they replace.

[3]Gouldner, op. cit., p. 246.

system elements "leads research attention away from systematic efforts to develop and validate generalized propositions concerning the manner in which eccological and other properties of the physical environment of groups structure patterns of social organization."[1] In short he believes that analytical devices which Parsons purports to provide ignore the significance of a number of elements which may be crucial for the development of adequate sociological explanations of phenomena.

We are confronted then, with a number of comments regarding the selection of system parts or elements. First there is the implication that systems are empirical entities rather than patterns of elements (or variables) in interaction delimited by the scientist observer. Second, there is the problem of the means by which the variables of the system are selected. That is are they to be determined on an a priori logical basis or are they to be found through successive empirical testing? Third, theoretical determination of system variables leads to the elimination of some variables which are important in accounting for system behavior at least in part because of its arbitrary nature in stating what constitutes a system. Fourth, in any case, patterns of social behavior can only be partially explained because social systems are open and partial and not all variables can be included.

These problems may be dispelled through the use of two of the major decisions about systems which were stated in Chapter IV. The question of the "reality" of systems can simply be ruled irrelevant by using the definition of a system as a conventionally selected set of variables which interact. This set will doubtless be a sub-set from a larger set but they provide a delimitable unit. The conventional selection of variables has to do with the second of Gouldner's problems. This selection is conventional but it is to be understood this does not imply

---

[1] Ibid.

arbitrariness, unreasonableness, or radical departure from that common sense behavior which there indeed must be in order to begin the process of determining the variables to be included. This common sense may be based on theoretical considerations and in sociology this would appear to be a feasible approach if theoretical is taken to mean derivable from a set of laws or lawlike statements based on the present knowledge of social interaction. However, theory is not a necessary part of the basis for variable selection or determination of a delimitable unit to be called a system. Some observation of a given setting, for our purposes here, of a given organization, will lead to the possibility of a rational, perhaps tentative, selection of variables presumed to be interacting and presumed to be the significant variables for analysis. Once this conventional selection has been made it becomes necessary to make the necessary empirical observations to determine if these variables do interact and whether these interactions are the significant relationships for the system in question. That is, do these variables and their interaction explain the behavior of the system and enable predictions regarding its behavior at a time different than that of any given observation.[1] In other words Gouldner's second problem is reduced to recognition that both a priori and empirical behaviors are required in the selection of system elements or variables. It may help to clarify this problem if the distinction between the context of discovery and the context of verification in science is recalled. Determination of the elements to be included in a system is initially in the context of discovery. Empirical test of the accuracy of including them falls under the context of verification. There seems to be little doubt that Gouldner

---

[1]This is such a simple statement that it appears necessary to acknowledge its deceptive nature. If variables can be determined which explain the behavior of a system sociology will have made a great stride forward. The problem of prediction in functional analysis is severe. The reader is referred to Hempel for a discussion of the question. See "The Logic of Functional Analysis" in Symposium on Sociological Theory, L. Gross, ed., (Evanston, Row, Peterson and Co., 1959).

would agree with this statement but his focus is on the empirical nature of the process of final selection. This ruling also bears on his third question regarding the probability of eliminating important variables. Part of this problem has to do with this empirical test of those variables which are initially selected for inclusion and the necessary addition of new variables or elimination of previously included variables which must be carried out in the process of empirical test until the set finally selected provides explanation of behavior patterns of the system. Once this set of variables is established the system has been defined. An additional aspect of the question here is relevant to the fourth problem Gouldner has specified, namely that patterns of behavior can be no more than partially explained because social systems are open systems. This might be restated somewhat as follows. Social systems are open systems and therefore there is interaction among a wide variety of variables some of which must be eliminated from analysis for practical purposes alone, i.e. the limitations on the volume of work to be undertaken. However, any such exclusion runs the risk of eliminating from consideration a variable which is significant for explaining of the system.

Clarification of this issue is provided by the conceptions of variables and parameters of the system previously examined. Any system operates in an environment. The ranges of the relevant properties of the elements construed to be a part of the system are the system's variables while elements in the system's environment are the system parameters. The parameters become effectors of system change; that is, there are external as well as internal sources of change. Some system parameters will have a greater effect on system behavior than others and the task is to determine those which are significant for the system. Efforts at measurement are concentrated on system variables however.

There is a certain cavalier nature to this suggestion of empirical test to determine the significant variables for a system which must be acknowledged. In describing this determination Ashby refers to the "primary operation." Accordingly the experimentor attempting to select the main or significant variables of a system will make his common sense selection and then proceed to test by bringing the variables to a selected state after which he will release some and control others. The experimenter follows the course of the released variables and records their behavior. The power of this method lies in the fact that it can be repeated with variations systematically applied and the different responses provide the answer to the significance of change in a given variable for the system as a whole.[1] Unfortunately sociologists are rarely experimenters in this classic sense. They do not have the power to "control and release" variables in the systems they are concerned with--certainly this is the case in bureaucratic organizations. It may be added that they are not alone among the scientists who have this problem; biologists and meteorologists are obvious brethren. Their systems are accessible to observation but usually not to experiment. In these instances the observer must watch the variables of his system over a period of time to determine their importance and the importance of their interrelationships. Obviously there must be some precision in recording the behavior of the system variables in order that reliable comparisons may be made and if this is carefully done less observation will be required before the emergent patterns are recognizable. For this reason alone it is apparent that a major effort of sociology continues to be directed toward the technological aspects of its methodology for measuring devices are imperative if the logical aspects are to proceed to an optimum point.

---

[1]Ashby, op. cit., p. 18.

Nevertheless, the sociologist's testing of the significance of the variables he includes in a system is likely to be a time consuming problem. It is no simple task.

Technological problems aside, the concepts of variables and parameters of the system help to relieve that part of Gouldner's concern with the limitations on explanation of social behavior which stems from the observers inability to take all possible relevant variables into effect. An additional clarification may be made with regard to the open system which he suggests is a major reason for the limitation on explanation. If we understand Gouldner he finds that because social systems are open systems, many of the stimuli or conditions which account for variance in particular social patterns will fall outside the given system and therefore system analysis will never provide a complete explanation of social patterns. This implies an infinite expansion of the variables to be included in a system in an attempt to account for more and more of the system's behavior. He seems to be saying systems are so complex it will never be possible to take all the relevant information into account when predicting the state of a system at time t_1 on the basis of its state at time t.

However, if the important variables of a system are located and are measurable to the extent that it is possible to provide a state description of the system at time t and if there is a theory which permits deduction of the description of the system at time t_1 at least to the extent of an acceptable level of probability, then the social behavior pattern has been explained regardless of the fact that other variables may also influence the system or play a part in its behavior. Increased precision in measurement and increased ability to handle additional variables may increase the size of "p" and in this sense the cumulative function of science is enhanced by continued pursuit of new variables

which may be relevant to the system until such time as some optimal state of explanation and prediction is reached.[1]

Functional Reciprocity

Gouldner's second major focus is on what he refers to as the "principle of functional reciprocity." Several quotations will serve to define this principle. "Essentially, the principle of reciprocity implies a system of interdependent parts engaged in mutual interchanges."[2] ". . . the formal adequacy of a functional explanation of the persistence of a social pattern would seem to require that the analyst demonstrate not merely the consequences of A for B, but also, the reciprocal consequences of B for A."[3] He attempts an explicit statement of the principle as follows: "(1) Any one structure is more likely to persist if it is engaged in reciprocally functional interchanges with some others; (1.1) the less reciprocal the cuntional interchange between structures, the less likely is either structure, or the patterned relation between them, to persist; (1.2) unless compensatory mechanisms are present."[4]

Gouldner stresses that the principle does not necessarily imply that the reciprocity is symmetrical. It may be asymmetrical in that the consequences of A for B and B for C are reciprocated through the

---

[1]What this optimum will be depends on the range of error permissable for the problem involved. A rather low probability of change might be acceptable in administering a drug expected to influence the course of the common cold among those so distressed. A very high probability might be desirable for scientific theory underlying diplomatic strategy in effecting control of atomic warfare among a system of nations.

[2]Gouldner, "Reciprocity and Autonomy," op. cit., p. 249.

[3]Ibid.

[4]Ibid.

consequences of C for A.[1]

Compensatory mechanisms which may replace reciprocity, are typed as (1) "culturally shared prescriptions of unconstrained generosity such as the Christian notion of 'turning the other check,'" (2) "cultural prohibitions banning the examination of certain interchanges . . . such as the . . . cliche 'Its not the gift but the sentiment that counts'"; (3) "power arrangements" and (4) "mutual sharing by structures A and B, of some third structure C."[2] He concludes that explanation of a social pattern demands empirical test of the occurrence of functional reciprocity and failure to establish it requires searching out the compensatory mechanisms which are substituted for reciprocity.[3]

Gouldner also suggests that the anthropological concept of "survivals" is intimately related to this conception of compensatory mechanisms. A "survival" is a social pattern for which it cannot be established that it makes any contribution to the system in which it is presently implicated. He believes that the arguments against the notion of "survival" were based on an unqualified principle of reciprocity and that such arguments can be fruitfully replaced with analysis of the asymmetrical patterns of functional reciprocity.[4]

There are a number of questions regarding this explication of the principle of reciprocity. Perhaps it is well to begin with some comments about the matter of interdependence of parts since Gouldner sees this as central to his entire analysis of functional theory. He indicates that interdependence is problematic and cannot be assumed. It is difficult to see that this is anything more than a repetition of his earlier

---

[1]Ibid.

[2]Ibid., p. 250.

[3]Ibid., p. 251.

[4]Ibid.

insistance that the selection of system parts must be made on an empirical basis for if the definition of "system" is accepted as "variables in interaction" and if empirical test is made to determine whether there is interaction before a variable is finally accepted for inclusion in a system then some form of interdependence seems to exist by definition. The problem resolves into a distinction between the two terms "interaction" and "interdependence." Gouldner appears to take the position that interdependence implies interaction but that the reverse is not the case. The task becomes determination of the logical demands of postulation of interdependence in addition to interrelation of system parts. Review of the characteristics of functional systems will be of assistance here for purposes of settling this question. A functional system is teleological--it has a goal state. Further, in the functional system there is a chain of states which lead to the goal state or that is, a property of some element of the system is either a sufficient or a correlated condition with the occurrence of an end state which is in turn, a necessary or correlated condition for the occurrence of the goal state of the system. This formalized analysis indicates that there is a requirement of interaction among system elements in functional systems. However, it does not appear necessary to postulate a principle of reciprocity in this context. System elements play a part in maintenance or achievement of goal states for systems as a whole. Whether or not these elements have a reciprocal relationship or in Gouldner's terms "have varying amounts of their needs satisfied by . . . other system elements" may simply be confounding the problems of functional analysis.[1] To say the least such statements about system elements tends to anthropomorphize them; perhaps this reflects the

---

[1]Ibid., p. 254.

the fact that in social systems parts do include human beings.[1]

There are several additional problems with the reciprocity principle. Among these is the appended clause "unless compensatory mechanisms are present." Through this clause the observer is called upon to establish the reciprocity of system parts and failing to do this he must demonstrate compensatory mechanisms. This clause may make it impossible to refute the principle. There is the insistence that observation establish the empirical fact of compensation. Suppose the observer attempts to establish functional reciprocity and failing to do this seeks the compensatory mechanism and then fails to find these. Is this due to his inadequacies as an observer, the complexity of the system he is observing or the fact that there are neither reciprocity nor compensatory mechanisms?

There is an additional probably more devastating problem with this clause which is as follows. It enables such explanations as: If an element is present in a system it is in a reciprocal arrangement with other system parts or there are compensatory mechanisms present. At time t the part is present in the system. Therefore it is in a reciprocal arrangement or there are compensatory mechanisms present. This is an uninformative explanation. But apply the same principle to predictive efforts and it comes out as: If a part is a system part at time t_1 it is in reciprocal relationship to other system parts or compensatory mechanisms are present. This is akin to a redefinition of a system. Roughly, if

---

[1]Such anthropomorphizing may reflect a tendency of American Sociology to view social systems in terms of the individuals involved in them which could in turn imply a necessary reduction of sociological laws to psychological terms. Brodbeck has provided a statement apropos, ". . . since a group concept refers to a complex pattern of descriptive, empirical relations among individuals there is no reason why the behavior of this complex should not itself be studied. Psychological laws may be ubiquitous, but social laws may be formulated without taking them into account." "On the Philosophy of the Social Sciences," Philosophy of Science, Vol. 21, No. 1, (April, 1954).

reciprocity refers to "contributary to the G-state of the system or sub-system," and this appears to be a safe interpretation of Gouldner, then the statement is a tautology and simply does not contribute any information of predictive import.

To make all of this even more complicated Gouldner has carefully stated his principle in terms of likelihood. That is a "structure is more likely to persist [etc.]."[1] To establish the statistical probability of an event with the precarious testability held by the reciprocity principle seems to complicate the problems of functional analysis beyond its limitations, albeit the probability statement is a necessary complication.[2]

These comments about reciprocity have been made as if Gouldner refers to system parts but it is not entirely clear that he is discussing reciprocity at this level. He uses Merton's analysis of the latent functions of political machines in the United States as illustrative of the necessity of a principle of reciprocity. "The explanation is incomplete insofar as the analyst has not explicitly traced the manner in which the groups or structures, whose needs have been satisfied, in turn 'reciprocate' and repay the political machine for the gains it provides them."[3] Here it would appear he refers to a sub-system. Again he refers to the "functional explanation of the persistence of a social pattern."[4] Again "The only logical, stable, terminal point for a functional analysis is not the demonstration of a special pattern's function for others, but the demonstration of the latter's reciprocal functionality for the problematic

---

[1]Ibid., p. 249.

[2]There seems to be some danger in the "likelihood" statement that it may become an escape hatch rather than an attempt to specify an actual probability. Just which of these possibilities is correct with reference to Gouldner is not determinable.

[3]Ibid., p. 249.

[4]Ibid.

social pattern." We have then, references to groups, structures and patterns, all in the context of the principle of reciprocity. For that matter in his statement of the principle he refers to the persistence of a "structure." Then, in his analysis of the principle he talks of "interdependent parts engaged in mutual interchanges."[1]

Some clarification of meaning is provided in a direct statement from Gouldner in his chapter on organization analysis in Sociology Today where he says "In speaking of an organization's parts, I refer both to its group structures or roles and to the socialized individuals who are its members."[2] The sentence suggests then, that "group structure" and "role" are synonomous and that either of these as well as individuals may be considered as system parts. Again there is this confounding of levels of analysis which seems to make the reciprocity problem more complex. In the same source there is further discussion of the principle of reciprocity labeled the "reciprocities multiplier." Gouldner indicates that reciprocity is a function of the degree to which an act is desired multiplied by the extent to which it is viewed as voluntary.[3] Surely this is a reference to human interactions but it must be indicated that its purpose in context was to refute Parsons' contention that once complimentary role expectations are established no reinforcement is required to maintain them.

It appears that for Gouldner, structure, pattern and individual are interchangeable terms referring to system parts. If it were possible to select a precise definition of any one of these terms and to accept the conclusion that he uses them synonomously there would be no problem other than that confusion which might arise from already established definitions of one or more of the terms which was troublesomely divergent

---

[1]Ibid.

[2]Gouldner, Organizational Analysis, op. cit., p. 419.

[3]Ibid., p. 423 ff.

from Gouldner's use. That trouble could be overcome. However, no such precise definition is provided. Finally, there are instances where it appears that a social pattern is not the system part but the system. This ambiguous terminology perhaps reflects an ambiguity in the levels of systems involved. The criteria in Chapter III provide clarification.

System parts may be the elements of a system and at this level of complexity analysis is concerned with the interrelation of parts which constitute the system. The parts or elements vary in condition but can hardly be conceptualized as having "needs" or, in our terminology, goal states. The condition of an element may vary with the variations of a second element but this does not imply the relationship is reversed. "If A varies B varies and it is the case that B varies," does not permit the conclusion "A varies." Nor does it demand that A be influenced by the change in any other variable.

At the next level of complexity are those systems which include sub-systems rather than single elements. Patterns of behavior or social patterns may be sub-systems which constitute a larger system. Discussion of sub-systems in the context of Gouldner's theory will be deferred to the analysis of functional autonomy in the next section but it may be stated that the comments here which refer to elements also hold for sub-systems in so far as functional reciprocity is concerned. It is true that reciprocity is conceivable for teleological sub-system since they have G-states which could be construed as "needs to be satisfied." However, there seems to be no advantage in conceptualizing the interrelations of sub-systems in terms of reciprocity. This will be clarified in the next section.

"Compensatory mechanisms" also need definition beyond the list of examples. Gouldner states that ". . . compensatory arrangements . . . provide a functional substitute for reciprocity."[1] There are then, functional reciprocity among system parts and functional substitutes

---

[1]Gouldner, "Reciprocity and Autonomy," op. cit., p. 251.

for functional reciprocity. But if these functional substitutes which are exemplified by power, norms and sanctions are treated as additional system elements the need for a principle of reciprocity with a disclaimer clause may be obviated. Explanation of a functional system can, in principle, be arrived at through analysis of system parts including the so-called compensatory mechanisms in terms of the interaction of these parts in the process of system adaptation.

Finally, as indicated, Gouldner sees "important connections between the principle of functional reciprocity and the older anthropological concept of a vestigial 'survival.'"[1] He concludes that the strong objections to this concept of survival were based on the assumption of an unqualified principle of reciprocity which led to the demand to find the hidden reciprocity which must exist if a system part persisted although no obvious reciprocity was found between it and another system part. He believes that the problem of survivals is better considered in terms of asymetrical patterns of functional reciprocity.

Searching for the conditions under which a certain social pattern persists may be system analysis as we are proposing it here. Determination of the nature of the system--is it teleological, is it functional and what are the sub-systems--are all part of the analysis. If a sub-system has persisted it may be concluded that it has adapted where necessary and to label this a "survival" seems to add nothing to understanding except to say that the observer has been unable to find any dependent relationship of this sub-system on another sub-system within the complex he is studying. If he wishes to determine the nature of the persistence of this particular system he may attend to it in the same manner described for any system analysis. Insofar as such analysis is concerned neither concept--reciprocity or survival would seem to be of particular assistance. There seems to be no good reason for demanding that any element which

---

[1] Ibid. This discussion does not appear to be central to his analysis but it is mentioned here because of its persisting interest to sociologists and anthropologists.

might be associated with a group of elements making up a system be explained in terms of the reasons for its existence. The focus of attention is not on alternative items which may fulfill functional requirements but on the circumstances under which systems may adapt.

The relationship of this problem to Merton's discussion of the postulate of universal functionalism is obvious. He would revise this postulate to make it an assumption that any given item may have functions or to a provisional assumption that persisting items have a net balance of functional consequences. One of his statements is especially pertinent. "It can be said that even when such survivals are identified in contemporary literate societies, they seem to add little to our understanding of human behavior or the dynamics of social change. Not requiring their dubious role as poor substitutes for recorded history, the sociologist of literate societies may neglect survivials with no apparent loss."[1]

Finally, if empirical test is a necessary part of the determination of elements in a system, and it has been established that this is the case under the conditions described previously, then those elements or even sub-systems which have been characterized by the title "survival" would not be accepted as central to system behavior because by definition they cannot be found to have any effect on the system's adaptation.

In summary, the point of these comments is not whether the principle of functional reciprocity is true or false but that it is an unnecessary and confounding principle.[2] This juncture provides an opportunity to explore somewhat further an important distinction which must be adhered to in interpretation of the comments here concerning organization theory. It has been indicated that the concern is methodological rather than theoretical and in order to further clarify this point certain comments may be included as to what implications are and are not made by the

---

[1]Merton, Social Theory and Social Structure, op. cit., p. 31.

[2]See appendix B for a diagram which attempts to show the relationships which have been analyzed in this section.

conclusion offered that the principle of reciprocity is unnecessary. This conclusion refers only to Gouldner's statement of the principle of reciprocity and to the context within which he places the principle. Whether some form of this principle is relevant and useful in some other theory in sociology is not determinable from the methodological operation which was carried out here and which refers only to a specific theory under analysis.

For example, Merton and his followers have used the concepts of institutionalized evasion of norms and emerging compensatory mechanisms as part of a theory for predicting the emergence of new systems. Thus Merton states, "Evasions of the norms may become functional for the group, and often, as a prelude to structural change in the group, there develops a more or less persistent phase in which these evasions become institutionally patterned," and "It may be conjectured that an appreciable amount of tolerated deviation from norms is functionally required for the stability of complex social structures."[1] These statements would doubtless be, at least roughly, comparable to Gouldner's principle of reciprocity in so far as he adds the clause regarding compensatory mechanisms. Further the "tolerated deviation" might be akin to Gouldner's "dedifferentiation," to be discussed later. The point here in no way refers to the validity of Merton's analysis. To impute such a reference would be to make a serious misapplication of the results of the model analysis. It was suggested above that analysis of compensatory mechanisms could be carried out in terms of the interaction of system parts in the process of system adaptation and it may be added now that this very point demonstrates that there is no intent here to dismiss the postulates of Merton and others regarding compensatory mechanisms under whatever label. It is only to the principle Gouldner states and to the way in which it is stated that the analysis refers.

---

[1]Merton, Social Theory and Social Structure, op. cit., p. 318.

Functional Autonomy

The last major problem to which Gouldner addresses himself is functional autonomy of system parts. He considers this in terms of degrees of interdependence, system tension and structural dedifferentiation. He makes it clear that he is working from a crucial assumption that there are "varying degrees of interdependence which may be postulated to exist among the parts of a system."[1] He defines functional autonomy in what he calls operational terms as "the probability that a part can survive separation from the system."[2] He focuses on functional autonomy to demonstrate the significance of autonomy for system tension and thereby to contribute to the analysis of social change. Thus, a low degree of "systemness," that is a low degree of interdependence of parts is a result of, or at least a reflection of, high functional autonomy of system parts which in turn results in system tension and system tension is the force for social change.

"It must be assumed that parts with some degree of functional autonomy will resist full or complete integration, [while the system] can be expected to seek submission of the parts to the requirements of the position they occupy. Consequently, there may be some tension between the part's tendency to maintain an existent degree of functional autonomy and the system's pressure to control the part."[3] "To fit the data of social behavior, the system model required must be such as to facilitate not only the analysis of the interdependence of the system as a whole but also the analysis of the functional autonomy of its parts, and the concrete strains which efforts to maintain this autonomy will induce."[4]

Gouldner provides some revealing examples to illustrate his point. These have to do with Freudian theory which postulates a conflict between

---

[1]Gouldner, "Reciprocity and Autonomy," op. cit., p. 254.

[2]Ibid.

[3]Ibid., p. 255.

[4]Ibid., p. 256.

the individual and the society, Hughes' studies of persons in various occupational groups and Goffman's analysis of deference behavior of individuals in mental hospitals. Note that each of these examples is concerned with the behavior of individual persons as parts of social systems.

There is no intended implication here that people are not parts of organizations but it is tentatively suggested that organizational system parts need not necessarily be viewed in terms of the individual occupants of roles within them. Indeed this very insistence on individuals as system parts leads to complications of the rapproachment of supra-systems since organisms are "systems."

We are persuaded, temporarily at least, to suggest that while there can be no doubt that the goals of the individual organism as a system have an influence on the extent to which that individual is integrated into a social organization, the goals of the organization are distinct from these individual goals and are not materially affected by them. The statement is little more than the old notion that individuals are expendible and it is a statement requiring empirical test in this context but it is further suggested that organizational analysis might more successfully proceed at the next level working on the assumption that this proposition is true.[1] This is, of course, a statement of opinion.

Another crucial statement Gouldner provides regarding functional autonomy is that "a need of a system, which possesses parts having degrees of functional autonomy, is to inhibit its own tendencies to subordinate and fully specialize these parts. In short, it must inhibit its own tendencies toward 'wholeness' or complete integration if it is to be stable."[2] His major conception of system is provided in the following statement. "Organization is seen then, as shaped by a conflict, . . . as limiting

---

[1]Dr. Charles Loomis has suggested that if the concept of actor, rather than reference to individuals, were maintained throughout an analysis at least part of the problem might be obviated.

[2]Gouldner, "Reciprocity and Autonomy," op. cit., p. 257.

control over parts as well as imposing it, as establishing a balance between their dependence and independence, and as separating as well as connecting the parts."[1]

These statements provide an outline of Gouldner's general conception of functional autonomy and its relevance to system tension, change and stability. His position is elaborated however. He indicates that because system parts may strive to have or maintain different degrees of functional autonomy does not lead to the assumption that all have an equal role in generating system tension nor can it be assumed that all parts are equally involved in resolution of system tension. ". . . those parts with least functional autonomy, those which cannot survive separation from a social system, are more likely to be implicated in its conservation than those which can."[2] Gouldner uses some interesting metaphors in further pursuing the strategy of functionally autonomous parts of a system. Accordingly, he finds that there are three different ways a part can react when it is not totally dependent on the larger system for "the satisfaction of its own needs." The part may withdraw and "go into business for itself and resist such a high degree of specialization that it loses power to service its own minimal metabolic needs." Another mechanism is for the part to "spread its risks," by gaining satisfaction of its needs from a number of systems. Third, a part may undertake reorganization of the entire system, that is "functionally autonomous parts may have a 'vested interest' in changing the system."[3]

The other protagonist in this conflict, to continue in metaphors, is the system. There are three strategies which Gouldner proposes the system can employ to cope with the tension resulting from the behavior of functionally autonomous parts. First the system may "insulate itself and withdraw its parts from the environing system, excluding or 'alienating' parts possessing significant functional autonomy, admitting only those it can highly control, and refusing to share parts with other systems."[4]

---

[1]Ibid.

[2]Ibid., p. 258.

[3]Ibid., pp. 259-260.

[4]Ibid., p. 260.

A second strategy is that of expansion in which the "system attempts to engulf others which share its parts and thereby tighten control over them."[1] "A third strategy is that of 'selective risk.' . . . the system will maximize its security by delegating its basic metabolic needs to structures within it which have minimal functional autonomy."[2]

These strategies of parts and of systems are of course conflicting behaviors and it is to be expected that efforts of either the system parts or of the supra-system will result in resistance. That is, efforts at changing the system and efforts at maintaining it will both result in resistance, the first from the whole system and the second from the autonomous system parts.

Gouldner completes his analysis with a discussion of an advantage which accrues to the system which has functionally autonomous parts. These systems are said to have the potentiality for "dedifferentiation." Dedifferentiation refers to the capability of the system characterized by functionally autonomous parts to "destructure itself into component primary groupings, surrendering its sovereignty to the parts."[3] This action entails giving up higher levels of organization for a regrouping of autonomous parts at a lower level of complexity. In this kind of situation functional autonomy is a basis for response to system tension and for this reason such autonomy is not an umitigated source of difficulty for the system. It may provide a basis for defensive strategy. Dedifferentiation is clearly seen as a reaction of a system seriously threatened with collapse. Thus such references as "defensive strategy of last resort," "defense of systems in the face of extremity" and "response available to an extremely disruptive stimulus."[4] Functional autonomy of parts in a social system is a significant focus for attention because it "aids in identifying possible loci of

---

[1] Ibid.

[2] Ibid.

[3] Ibid., p. 261.

[4] Ibid., pp. 261-262.

strain within the system as well as marking out the boundaries along which dedifferentiation may occur."[1]

These paragraphs have been intended to give an outline of Gouldner's functional theory as presented in the Symposium on Sociological Theory. In his discussion of organization in Sociology Today he reiterates several of these concepts. Because of the context and the resultant condensation of the presentation there is little which adds further to our understanding except that there are certain pertinent examples offered. He refers to functional autonomy of parts and in the same context adds that in an organizational context an "example of asymmetrical interdependence would be the relation between the production and the public-relations departments of a business firm. If the two are somehow disjoined, the former normally has a higher probability of survival then the latter."[2] Here is an example of functionally autonomous parts which refers to sub-systems of the larger organization and these are clearly not individual persons. He further makes an assertion which is relevant for systemic analysis of organizations. ". . . an organization as such cannot be said to be oriented toward a goal, except in a merely metaphorical sense, unless it is assumed that its parts possess a much lower degree of functional autonomy than can in fact be observed. The statement that an organization is oriented toward certain goals often means no more than that these are the goals of its top administrators, or that they represent its societal function, which is another matter altogether."[3] Obviously this comment requires attention in any analysis of the application of a teleological system model to a theory of organizations. It is a rather forceful statement that the organization as a whole has no goal(s) except the multiplicity of sub-goals of the different sub-systems. The proposition is

---

[1]Ibid., p. 263.

[2]Gouldner, "Organizational Analysis," op. cit., p. 419.

[3]Ibid., p. 420.

equivalent to a statement that a G-state will be problematical or impossible to determine for the organization as a whole since goals belong to the sub-systems. An organization is then a collectivity of sub-systems with g-states but it is not a teleological system en toto.

The three major points which constitute Gouldner's analysis have now been defined. Briefly, he is first concerned with the establishment of system parts on an empirical rather than a "theoretical" basis. It was suggested here that the most fruitful procedure combines these two approaches through a conventional selection of parts, empirical test of the significance of these a priori selections and retesting until the significant system variables are determined. Second he emphasizes the concept of functional reciprocity which he states in a formal principle reflecting the hypothesis that relations between structures and the structures themselves are less likely to persist if there is no reciprocity in their relations unless there is some compensatory mechanism operating. It was indicated that this principle may be unnecessary and complicating for the analysis of systems.

Finally, Gouldner finds that system tension, the resultant system change and system survival can be explained through the concept of functional autonomy of system parts. This last conception appears to be the most difficult of the three areas of concern to Gouldner perhaps because it is the most encompassing in breadth and because it deals with some of the most complex aspects of system analysis including the relation of a set of teleological sub-systems to a larger system and the compelling problems of system persistence and change.

Gouldners conceptualization might be outlined as follows:

I. System Change:

> A social system (organization) consists of a set of parts with varying degrees of functional autonomy, i.e., these parts have varying abilities to survive separation from the supra-system.

In straining to maintain their functional autonomy these system parts create system tension since the system attempts to reduce their autonomy.

The strain to maintain functional autonomy, resulting in system tension, is the source of system change, i.e., the supra-system is forced to change in order to keep the parts within the system or is changed by virtue of removing the parts from the system.

II. System Persistence:

A social system (organization) consists of a set of parts with varying degrees of functional autonomy.

The autonomy of these parts provides a resource for system defense in the event of a catastrophic stimulus from outside the system.

The restructuring of the system around its autonomous parts is the source of system persistence.

Certain implications immediately become apparent with the above formalization. It appears that external stimuli initiate both persistence and change of a system. This is effected first by stimulation causing change through restructuring on the basis of some kind of use of functionally autonomous parts which in turn, results in persistence or survival of the system but in a new arrangement. Change of the system may also be brought about by strain due to the functional autonomy of the system parts or in other words may come from within the system. Sources of change then are both external and internal. Persistence, on the other hand, is brought about by external conditions. Persistence in any other sense in this schema is the result of a static condition. The system which has no external threat and persists without changing would apparently be a system in which there was a stalemate among the functionally autonomous parts and the system struggling for control. Such a condition may be a state of equilibrium but Gouldner, while indicating "the two most important

aspects of system analysis for the sociologist are interdependence of system parts and the tendency of these parts to maintain equilibrium in their relationships," chose to exclude attention to equilibrium in his analysis.[1]

A comparison of this outline with the criteria for system analysis stated in Chapter IV will now be useful.

There is a major disjunction in Gouldner's analysis which must be resolved. It was suggested previously that when he states that ". . . an organization as such cannot be said to be oriented toward a goal. . . ." he is denying that the organization is a teleological system. At the same time his analysis demands a conception of teleological systems when he explores the possibilities of system tension and dedifferentiation since these concepts embody the notion of a system struggling to maintain itself against the autonomy of its own sub-systems and against threatening outside stimuli. It seems we must insist Gouldner is talking about teleological systems when he refers to organizations whether he thinks so or not. He is discussing functional systems which have been demonstrated to be a class of teleological system and he certainly implies a general law to the effect that functional systems develop appropriate traits to meet the necessary conditions for their continued adequate operation either invariably or with a high degree of probability. Survival is the G-state of the supra-system in Gouldner's analysis regardless of what other conditions of the system's elements are found to be a part of this G-state.

Further he posits that the organization has strategies which it employs to cope with autonomous parts and this must imply there is a supra-system goal if there is to be any point to the employment of these strategies.

It is clear that Gouldner's lack of concern with system G-states influences his discussion of functional autonomy and it may account for some of the problems which arise with it. Thus, Gouldner uses the

---

[1]Gouldner, "Reciprocity and Autonomy," op. cit., p. 242.

concept of functionally autonomous parts which may lead to system tension and change but which may also serve the system in time of stress by permitting it to utilize this very autonomy as a source of restructuring and ultimate survival. This emphasis is largely on the lack of systemness or the unrelatedness of system parts. It should also be re-emphasized that the entire formulation supposes a set of sub-systems rather than elements.

The section of Chapter IV dealing with sub-systems and their relationship to the supra-system provides the criteria to be applied here. That discussion attempts to determine the way a system retains its essential wholeness while consisting of parts with partial, fluctuating and temporary independencies. There is obviously a different focus in the two analyses. Gouldner stresses division of the system and tension. Here we stressed cohesion of the system and persistence. The significance of this difference in focus will become apparent in the following discussion.

Functionally autonomous parts may be compared with independent sub-systems. The former are parts able to survive separation from the system; the latter are sub-systems not affected by the action of any other sub-system in the whole even though their own action may affect other sub-systems. The most obvious reason for preference for the concept of independent sub-systems is that there is a possibility for empirical test of the extent to which such independence actually exists in an organization while the opportunity to determine the functional autonomy of a sub-system in an organization is not likely to occur. On formal grounds however, there are more compelling reasons for the greater power of the independency formulation. Ability to determine the independence of sub-systems and their relationship to other sub-systems and to the whole system provides a completeness of conceptualization which permits analysis of the persistence of systems and reasons for change on the basis of

scrutiny of (1) stimuli affecting parts, (2) the resultant adaptive behavior of the sub-systems, (3) the adaptation (the change) of the supra-system, and (4) the relationship of change to persistence of the system in its G-state.

Functional autonomy on the other hand appears to be based on an underlying conception of a dualism encompassing on one side a struggle to change the system and on the other a struggle to maintain it. The conception leads to the same problem which occurs with the principle of reciprocity, namely it explains behavior of the system in such a way that it is impossible to refute hypotheses based on it. Thus, the system changes because the functionally autonomous parts are winning in the struggle or because the supra-system is using them to restructure for purposes of survival. In this kind of formulation it is difficult if not impossible to rule out either side of a conflicting explanation.

The essential faultering of Gouldner's conception of organizations as goalless becomes apparent here. It would appear the student of a particular organization has no means for making a decision on empirical grounds of whether a sub-system is, in fact, a true part of the larger organization. If he approaches a bureaucracy and he finds that a certain segment of it is functionally autonomous as Gouldner defines autonomy, it may be that this segment is not a part of the system.[1] However, presumably a system part could be functionally autonomous, that is able to survive without the larger system, yet necessary to the supra-system for its own survival. If this were the case it would be appropriate to conclude the segment was a part of the system. But the conception demands the further assumption that because the part is autonomous the system which relies on it is in a continuous struggle to try to alter its autonomy. This would appear to entail the second of the three system strategies Gouldner prescribes for

---

[1]In this part of the discussion the term part is used synonomously with sub-system in order to simplify comparison with Gouldner and the terminology he uses. It is to be understood the reference is to sub-systems not to elements. The conception of a functionally autonomous element or an independent element seems fruitless.

the supra-system to use for coping with system tension. That is, the system would attempt to engulf other systems which share this part and thereby gain more control over it rather than to attempt to exclude the part upon which its survival is dependent, or to delegate its needs to other parts which have a minimum of functional autonomy. These two alternatives may be ruled out by virtue of the fact that the system is dependent on the autonomous part.

This chain of events cannot be stated as the only possibility. It may be that the strategy of delegating needs to a part with less autonomy is a possibility even though the system is presently dependent on the functionally autonomous part it is trying to overpower. System change then could be attributed to the attempts and possible success of the system to re-delegate its needs. The functionally autonomous part would no longer be a system part since it has never relied on the system and the system no longer relies on it. But, come the disruptive stimulus from the environment, the system is immediately in trouble for success in ridding itself of the autonomous part has removed the possibility for dedifferentiation which is its source of survival in crisis.

All of these machinations are presumably taking place in an organization with no goals.

There is an additional complication which arises with the Gouldner emphasis on the strain created by functionally autonomous parts. He appears to find it necessary that the system attempt to reduce the autonomy of the part and this leads to system tension. But it is quite possible to conceive of systems which do not show tension due to the autonomy of a part, but rather in which functional autonomy is a condition of the G-state of the supra-system. The functionally autonomous heart and circulatory system of the human organism or the executive head of a government bureaucracy provide examples. In these examples the supra-system is dependent on the functionally autonomous part but there is no tension produced by the autonomous nature of the part.

Now what improvement accrues from the alternative framework of analysis provided by attention to independent sub-systems proposed herein? This set of criteria defines teleological systems, that is, systems the operation of which is explained on the basis of teleological theories. The organization is seen as a teleological system with a set of sub-systems one or more of which may be independent of all others. While these independent sub-systems are not affected by variation in other sub-systems they do have an effect on the system as a whole and on at least one other sub-system. If they do not meet this criterion they are not parts of the system on the basis of empirical test.

An outside stimulus initiates a change in an independent sub-system A which "attempts" to maintain its g-state by changes in the values of its variables within the range permissible to these variables while the sub-system is in the g-state. This is adaptive behavior which initiates change in the values of variables in those sub-systems dependent upon A, i.e., change when A changes. There are then adaptive behaviors on the part of the dependent sub-systems whether they are immediately dependent upon A or are dependent through a chain relationship. Change of the system is seen as initiated from an outside stimulus but because of dependence of sub-systems there is a change throughout the supra-system to the extent of this dependency chain. Change is adaptation and adaptation is the means for system persistence. Both change and persistence or survival of a system are functions of the adaptation of sub-systems in response to stimulation from system parameters and to interrelatedness of sub-systems.

Independent sub-systems are unique only in that change is not initiated in them by action of other sub-systems but rather comes from their parameters. When such stimulation occurs these sub-systems demonstrate adaptive behavior which is the source of change within the sub-system and within the supra-system through their influence on the initiation of action of other sub-systems. This conception of system

relationships permits determination of the source of system change, its reverberations throughout a supra-system and puts it into a relevant rather than an oppositional relationship to system persistence. Change which is a reflection of adaptation is the means by which a system persists.

However, not all system change comes from adaptation to external stimuli through independent sub-systems. Dependent sub-systems may also be so set in action by external stimuli and this in turn initiates adaptive behavior of whatever sub-systems are in a dependent relation to them. The ultimate effect for the supra-system is the same regardless of the sub-system through which external stimuli act, that is, the sub-systems adapt in an attempt to keep their goal-states and through this adaptation the system may persist in its G-state. Of course, if the stimulation is too disruptive there is the possible result that the sub-system will lose its goal state and the supra-system may also move out of its G-state. System breakdown is a reflection of step-function changes in the variables of at least one sub-system which through losing its g-state led to loss of the G-state of the supra-system.

There is another kind of variable action which may occur within the system either as a result of external stimulation as described above or through changes within the system. This is the change of variables which are part functions. In this case variation occurs in variables of a sub-system on a periodic basis. That is there are periods of change and periods of constancy for the variables involved. This conception makes it possible to understand the adaptation and persistence of a supra-system with sub-systems having incompatible goals. In such instances the variables of a given sub-system may remain in a period of constancy outside the g-state of the sub-system due to its dependence on a second sub-system which is in its g-state or is moving toward it. When the sub-system is set into action from whatever source, the variables will enter into a period of change which will be selective toward the g-state of that sub-system.

There is then, a dynamic interaction among the sub-systems of the whole which is reflected in the change in some variables and the constancy of others. This interaction is altered with time through adaptive action. The supra-system made up of independent and dependent sub-systems, some of which have incompatible goals, will be in a continuous process of adaptation resulting in system persistence up to the point that the stimulation is so disruptive that variables are pushed beyond the range of variation the system can tolerate. The system tension which Gouldner proposes as an explanation of system change may be restated as the interaction of sub-systems in dependency relationships. Sub-system variables which are part-functions account for the possibility of adaptation of a set of sub-systems with incompatible g-states.

The automobile manufacturing industry may again be used as an example. It will be recalled that in the example in Chapter IV the sales, engineering and accounting departments were said to be sub-systems with incompatible g-states. For our purposes it may be assumed that the source of stimulation for change is within the supra-system rather than from an external source. None of these systems is independent since each is affected by changes in the others but a fourth sub-system which is independent may be added for purposes of illustration. Let this be the maintenance engineering department. This system has as its goal the maintenance of the production machinery. This sub-system also strives for survival but there is little danger that this goal will not be met since it is a necessary part of the supra-system and of the sub-systems involved in production. Should it fail to function or drastically alter its function, there would be immediate response from those systems dependent upon it but changes in those systems would have little effect on its operation.

The other three sub-systems however, will demonstrate continuous adaptation in an effort to achieve a goal state and for each one this adaptation will consist, at least in part, of reactions to variations in the other two. Our fantasy may permit the notion that the engineering department

is in the process of developing the perfect carburetor. This activity costs money and while engineering is in ascendance accounting will have to remain out of its g-state. Its part function variables will be in a period of constancy. Sales, at the same time, will also have variables in a period of constancy while it continues to sell cars with whatever carburetor has previously been installed. Let us say that the cost becomes too great, the variation is out of range for the sub-system of accounting and the part-function variables enter a period of change reflected in clamping down on engineering which will make the necessary compromise while accounting moves to its g-state. Let us say that the compromise results in a better carburetor but one which forces the raising of the height of the hood of the car above levels which the sales department believes can compete with the low-slung cars of other manufacturers. Another compromise, an adaptation, is required to reconcile the interrelationship of engineering and sales. The perfect carburetor then, provides an illustration of the way in which sub-systems with incompatible g-states will interact through variables within the sub-systems which are part-functions.

In place of Gouldner's hypothesis of functional autonomy as the source of system change and system persistence an alternative scheme based on the criteria for teleological systems iv provided. The alternative paradigm is as follows:

System change and persistence:

A social organization is a teleological system consisting of a set of sub-systems some of which may be independent (need not be affected by change in other sub-systems but do affect at least one other sub-system).

Some variables in these sub-systems may be part-functions (would exhibit periods of change and periods of constancy under certain conditions).

In striving to maintain or achieve a g-state, sub-systems force adaptive behavior of those sub-systems dependent upon them

and if they, in turn, are dependent sub-systems, display adaptive behavior in reaction to changes of those sub-systems, upon which they are dependent.

Adaptive behavior is accomplished through variables which are part functions and may therefore, remain constant for a period or vary for a period as necessary for adaptation and through step-functions which are instantaneous changes in values of variables pushed out of the range of permissible variation.

Stimulation for adaptation may be initiated from supra-system parameters or within the system in which case variables of a given sub-system are parameters for other sub-systems. In this sense all system change is initiated from parameters.

A final complication arises when the principle of reciprocity and functional autonomy are considered together. Gouldner's analysis as a whole, seems to include disjunctive concepts. It appears impossible to even imagine a system in which both the principle of reciprocity and the concept of functional autonomy coexist. Such a system would require that a part remain in the system only if it were in a reciprocal relation with other system parts but at the same time the part may be functionally autonomous, i.e., able to survive without the rest of the system. The system would be highly unstable at best since functionally autonomous parts by definition would not be reciprocated for their contributions to the system and would thus be only tentative parts of the system.

The disjunctive nature of this relationship further enforces the conclusion suggested previously that there is limited "systemness" in Gouldner's theory. The content of this chapter has demonstrated that the system criteria developed in Chapter IV do provide a method for cutting through the language of a theory to expose its framework to analysis of its logical consequences.

Other theories at the "Mertonian middle range" levels of complexity could be subjected to similar analysis with fruitful results. The conclusions

here raise certain questions about Gouldner's formulation. In short, we have shown that the criteria for a teleological systems model are capable of assisting to consummate the aims of the concepts he has defined in their initial stages.

In order to bring this into focus a rough comparison of Gouldner's concepts with the system criteria is given below.

Gouldner	System Criteria
Empirical additive selection of system parts	Empirical test of hypothesis that x is a part of the system
Reciprocity	Dependence
"Survivals"	Either a latent relationship to the G-state or not a relevant property of the system
Degrees of Functional Autonomy	Independent and dependent sub-systems
System change	Initiated by attempted adaptation of sub-systems to sub-goals
Persistence of system	Result of adaptation of supra-system to changes which results in persistence in its survival state. Adaptations may be reflected in the sub-systems.
System Tension	Part-functions
Dedifferentiation	Step-functions

Limitations

Finally, some of the limitations which accompany systems analysis, especially for sociology, must be mentioned and discussed. Limitations in the use and applicability of the system model are of at least three broad types; technological, practical and theoretical.

The practical limitations are most easily described. In working through this analysis, and perhaps in reading it, one may be left with a certain impression of the abstract nature of the whole construction. Can the system criteria really be applied to an empirical setting like those with which sociologists are concerned? Here this question will be investigated in terms of practical limitations which will hinder the empirical process. Foremost of these is the sheer difficulty of conceptualizing an organization in the complexity of system terms suggested here. There is little problem in the "as if" thinking involved in imagining an organization as a teleological system. But actual specification of its goal states, its system parts, (which of these are independent and which dependent), the interrelations of these sub-systems, the range of variation of relevant variables and the range of circumstances under which the system can reach its goal state are not simple operations. Some of these steps in analysis will simply have to be carried to only partial completion at this stage of the development of the technology of sociology. But over and above the technological problem there is the problem of the time and resources consumed in an attempt at such specifications and the relation of this cost to the fruitfulness of the results. There is little doubt, at least in the writer's opinion, that the more adequately such specifications can be made the more adequately will the theories of organizations fulfill the requirements of adequate theory. This is not, of course, to assert that only through pursuing each of these steps to completion will system analyses be useful and accurate. How an investigator is to determine the point at which further pursuit of these recalcitrant specifications is of diminishing value is not an easy question to answer. It is doubtless dependent in large measure upon the degree of complexity of the organization he is working with and how well he is able to proceed with some analysis in the absence of all of the information specified in the "perfect" analysis. It might be suggested that where great empirical complexity occurs models which are on a grossly simplified level probably always fail to perform their functions.

The methodological device for fulfilling the specifications which are suggested for system analysis is largely observation of the organization in action. There is usually if not always a severe limitation on the controls which an investigator may use in attempting empirically to study his organization so that it is difficult to make the empirical tests which are demanded. Frequently, only by a combination of accurate historical documentation and careful observation of the organization over time will he be able to determine, for example, which elements are the significant elements for the system in question or which are the significant interactions of its variables. And with the passage of time there will be adjustments in the interrelations of sub-systems and for that matter there may be changes in the elements or sub-systems which are significant for the system. Because of the time problem there is a strong compulsion to make decisions on the basis of going back in time and trying to determine what actually did happen with respect to the system parts. There appears to be no reason why such a procedure is inherently misleading but this approach in addition to the unavailability of laboratory conditions for the study of social organizations make predictions difficult to come by. The predictions which are practically possible are on the order of a specification that if some set of conditions holds, a given state of the system will be followed by another given state of the system. This does not say that the conditions mentioned will in fact occur; but in this respect, our predicament is no different from that involved in the predictions of the more developed sciences, say physics. The problem is one of setting up the empirical test where the conditions hypothetically specified do, in fact, obtain. This problem is not confined to the social sciences or to system analyses however. Biology has been confronted with the same limitations and has, with considerable success, developed theory which has been at least partially confirmed through compilation of historical data. The system analysis proposed may set a framework for the same construction of theory, with its concomitant specification of the data that must be looked for, as the evolutionists, for example, have been able to

construct for the evolutionary development of man.

The solution to these practical problems is a combination of conventional decision and compromise with the harsh realities of empirical research. Not all variables, not all ranges of variation, not all interactions of variables will it be practically possible to observe. The compromise is to accept this and proceed with the most detailed analysis of those variables which seem to be, always tentatively, the most significant. The conventional aspect is in selecting those variables at least for initial study. Successive approximation appears to be the ultimate hope in this procedure.

As can be surmised from the above comments the division of limitations into practical, technological and theoretical is not easily maintained in discussion. Technological problems intrude on the discussion of what have been called practical limitations. Another technological question is that of the measurement of variables in the system. There is nothing in the analysis of teleological systems which entails that variables must be metricized. The limitations on sociology's present capacity to give numerical values which conform to arithmetic principles does not preclude the use of systems analysis. In other words, if the elements in a subsystem of an organization are identified, changes in the properties of these elements may be specified in non-metrical terms, e.g., formal-informal, traditional-bureaucratic. There is the implication of some means for ordering these properties. However, while metricization is not mandatory, failure to do so leaves the investigator of social organizations without the use of the powerful logical tool of number theory. A perusal of the literature on systems analysis will quickly reveal that the explications of complicated material are usually aided by resort to arithmetic representations whether this be on the broad scale of the general systems theorists or the more circumscribed analysis of a particular phenomenon in system terms. If numerical examples are so useful for explanation of the logic of system analysis it would seem they may be

even more useful to its empirical application. There seems to be little doubt that if system analysis is to proceed to its most fruitful heights it will be accompanied by greatly improved techniques for metricization of system variables. The optimistic suggestion that this will be done is supported by the work of people interested in measurement such as Paul Lazarsfeld and Louis Guttman to mention two obvious contributors.

Another important and puzzling aspect of the metricization problem is involved but not in extricably, with the determination of probabilities for social theories. Statistical statements of the probability that an event will occur are intregal parts of the laws of sociology. This has perhaps led to a confusion regarding the necessity for metricized variables but in fact a statement that an event will occur with probability p does not in any sense require that the event be expressed in metrical terms. In other words to say that the chance of drawing a black ball out of an urn containing black and white balls is p says nothing about the size, or weight or intensity of the black or any other metrical characteristic of the ball. It does however, imply specification of the number of balls of each of the two colors (i.e., non-metrical properties) which are in the urn or the relative proportion of each. This is a problem of relevance to the specification that a goal state of a teleological system is the end state at which the system is most likely to arrive. A series of observations of systems would permit a probability specification but as we have recognized, repetitive observations of social organizations are hard to come by. It would appear that the solution to this problem is, as has been suggested, a combination of observation, historical data, and a rational determination of the possible end states and related sets of events which are likely to occur.

Dangers in the use of models in general as a means of developing theory provide a final consideration of the limitations in the use of the systems model. One danger is that of transferring the logical deductions

of the model on to the theory which results in the notion that these deductions are necessary in the theory. A true empirical theory of organizations must consist of true generalizations regarding the association of properties of elements. When a model is used logical conclusions will be deduced and there will be the expectation that empirical test will support these conclusions, especially when the model is itself a well-established theory, but should this fail to be the case the observed results cannot be rejected because they do not confirm the "fit" of the model. In the same vein, assertions which are analytically true in the model must not be transferred to the empirical theory and considered true by virtue of logical necessity. Empirical test is the measure of truth in the empirical theory. Teleological systems analysis must stand the test of its results as a methodology for the development of organization theory--at least as it has been discussed herein. Meanwhile the analysis does provide what appears to be a fruitful mode of approach. It is to be recalled that the analytic approach advocated does not give the specific empirical theory. Rather system analysis is seen as a methodologically sound way of looking at social organizations. The application of the criteria to the Gouldner theory provides one example of their ultimate usefulness.

REFERENCES

Arrow, Kenneth. "Mathematical Models in the Social Sciences," in The Policy Sciences, D. Lerner and H. Lasswell, Eds. Stanford University Press, 1951.

Ashby, W. Ross. Design for a Brain. New York: John Wiley and Sons, Inc., 1952.

Beck, Lewis W. "The Natural Science Ideal in the Social Sciences," Scientific Monthly. Vol. 68, June 1949.

Benjamin, A. Cornelius. "On Defining Science," Scientific Monthly. Vol. 68, March, 1949.

Bergman, Gustav. Philosophy of Science. Madison, Wis.: University of Wisconsin Press, 1957.

Bertalanffy, L. von. "General System Theory," General Systems, Yearbook of the Society for the Advancement of General System Theory, Vol. 1, 1956.

_____. "General System Theory: A New Approach to Unity of Science," Human Biology, Vol. 23, 1951.

_____. "The Theory of Open Systems in Physics and Biology," Science, Vol. 111, Jan. 1950.

Blau, Peter. The Dynamics of Bureaucracy. Chicago: University of Chicago Press, 1955.

Blumer, Herbert. "Sociological Analysis and the Variable." Amer. Sociol. Rev., Vol. 21, No. 6, Dec. 1956.

_____. "What is Wrong with Social Theory?" Amer. Sociol Rev., Vol. 19, Feb. 1954.

Boulding, Kenneth. "General Systems Theory--The Skeleton of Science," Management Science, Vol. 2, 1956.

Braithwaite, Richard B. Scientific Explanation. New York: Harper Torchbooks, Harper Bros., 1960.

Brodbeck, May. "Models, Meaning and Theories," in Symposium on Sociological Theory, L. Gross, Ed., Evanston: Row, Peterson and Co., 1959.

_____. "On the Philosophy of the Social Sciences," Philos. of Science, Vol. 21, No. 2, April, 1954.

Cannon, Walter B. The Wisdom of the Body, 2nd ed. New York: W. W. Norton and Co., 1939.

Carnap, Rudolf. "The Two Concepts of Probability," in Readings in the Philosophy of Science. New York: Appleton-Century-Crofts, Inc., 1953.

Cohen, Norris and E. Nagel. An Introduction to Logic and the Scientific Method. New York: Harcourt, Brace and Co., 1934.

Emerson, Alfred. "Dynamic Homeostasis: A Unifying Principle in Organic, Social and Ethical Evolution," The Scientific Monthly, Vol. 78, No. 2, February 1954.

Etzioni, Amitai. "Two Approaches to Organizational Analysis: A Critique and a Suggestion," Administrative Science Quarterly. Vol. 5, No. 2, Sept. 1960.

Feigl, Herbert. "The Scientific Outlook: Naturalism and Humanism," in Readings in the Philosophy of Science, H. Feigl and M. Brodbeck, Eds. New York: Appleton-Century-Crofts, Inc., 1953.

Gerard, Ralph. "A Biological Basis for Ethics," Phil. of Science, Vol. 9, 1942.

Gouldner, Alvin W. "Organizational Analysis," in Sociology Today, M. Merton, L. Broom, L. Cottrell, Eds. New York: Basic Books, 1959.

_____. Patterns of Industrial Bureaucracy. Free Press, 1954.

_____. "Reciprocity and Autonomy in Functional Theory," in Symposium on Sociological Theory, L. Gross, Ed. Evanston: Row, Peterson and Co., 1959.

_____. Wildcat Strike, Antioch Press, 1954.

Hall, A. and Fagen, R. "Definition of System," General Systems, Yearbook of the Society for the Advancement of General Systems Theory, Vol. 1, 1956.

Hempel, Carl G. "General System Theory and The Unity of Science," Human Biology, Vol. 23, 1951.

_____. "The Logic of Functional Analysis," in Symposium on Sociological Theory, L. Gross, Ed., Evanston: Row, Peterson and Co., 1959.

Huxley, Julian. Evolution in Action. New York: Harper and Bros., 1953.

Lienau, C. C. "Quantitative Aspects of Organization," Human Biology. Vol. 19, Dec. 1947.

Loomis, Charles P. Social Systems. Princeton, N.J.: D. Van Norstrand Company, Inc., 1960.

Meadows, Paul. "Models, Systems and Science," Amer. Sociol. Rev., Vol. 22, No. 1, Feb., 1957.

Merton, Robert. Social Theory and Social Structure. Glencoe, Ill.: Free Press, 1952.

Miller, James G. "Toward a General Theory for the Behavioral Sciences," Amer. Psychol., Vol. 10, No. 9, Sept. 1955.

Nagel, Ernest. Logic Without Metaphysics. Glencoe, Ill: Free Press, 1957.

_____. "Teleological Explanation and Teleological Systems," in Readings in the Philosophy of Science. H. Feigl and M. Brodbeck, Eds., New York: Appleton-Century-Crofts, 1953.

Novikoff, Alex. "Concept of Integrative Levels in Biology," Science. Vol. 101, March, 1945.

Rapoport, Anatol. "Uses and Limitations of Mathematical Models in Social Sciences," in Symposium on Sociological Theory, L. Gross, Ed. Evanston: Row, Peterson and Co., 1959.

Rudner, Richard. "The Problem of Functionalism," Second Research Conference, Michigan Department of Mental Health, 1959, Manuscript.

Simon, Herbert. A Formal Theory of Interaction in Social Groups," in Small Groups, P. Hare, E. Borgatta, R. Bales, Eds. Alfred A. Knopf, New York, 1955.

Simpson, Gaylord. The Meaning of Evolution. New Haven: Yale University Press, 1949.

White, Leslie. "Man's Control Over Civilization: An Anthropocentric Illusion," Scientific Monthly, Vol. 66.

_____. "The Energy Theory of Cultural Development," in The Ghurye Felicitation Volume, K. Kapodia, ed. Bombay: Popular Book Depot, 1954.

Wightman, W. P. D. The Growth of Scientific Ideas. New Haven: Yale University Press, 1953.

APPENDICES

APPENDIX A

Schematic Summary of Analysis in Chapters I-IV.

All Science

- Theory
  - Context of Discovery
  - Context of Verification

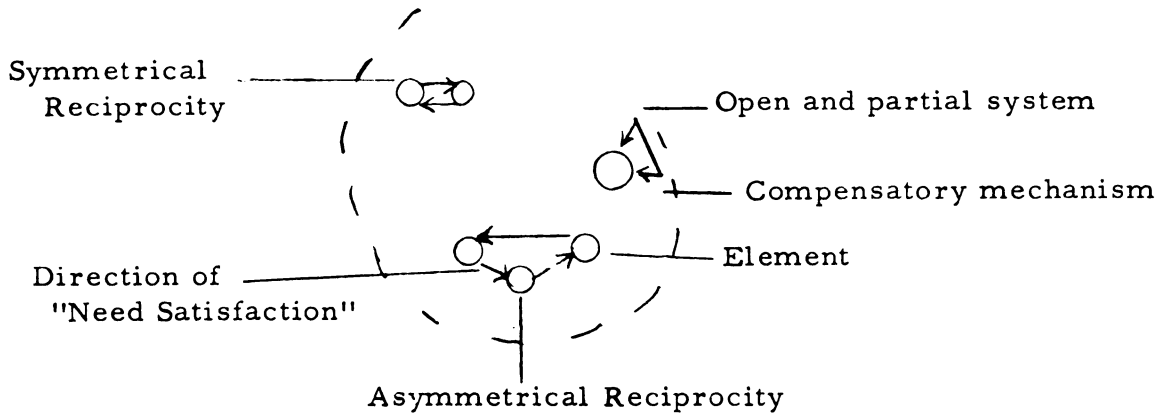
  } Hueristic Use of Models

- Method
  - Empirical
  - Technological
  - Logical
    - Models
    - Teleological Systems
      - Functional Systems
        - Steps in Analysis of:
          1. Is system teleological and functional?
          2. What is goal state?
          3. Circumstances under which G is achieved.
          4. Range of variation of system variables.
          5. What are the sub-systems and are they dependent or independent?

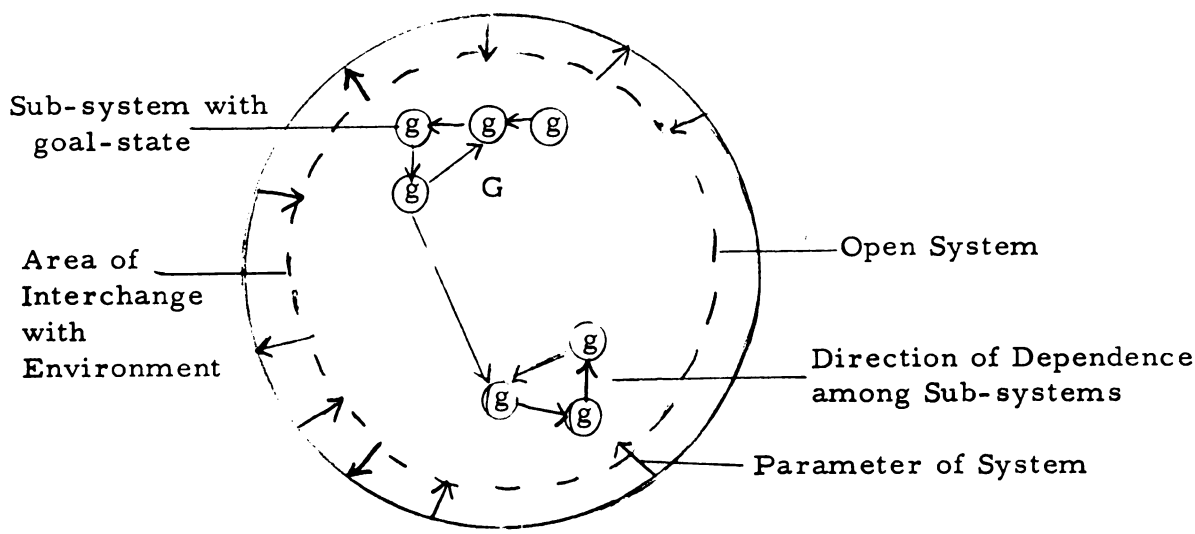
APPENDIX B

Diagramatic Comparison of Principle of Reciprocity and Sub-system Interaction

Reciprocity (after Gouldner)



Sub-system Interaction (System Criteria)



Sub-system with no arrow entering is independent.