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TOWARD A SCIENCE OF MEDIA ECOLOGY:

The Formulation of Integrated Conceptual Paradigms for the Study of Human Communication Systems

CHRISTINE L. NYSTROM

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Education of New York University

1973

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Christine L. Nystrom

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July 9, 1973

An Abstract of

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ABSTRACT

Media ecology is the study of complex human communication systems as environments. It takes as its basic subject matter the transactions between individual and reality, between one person and another, between individual and group, and between group and culture, and it seeks to identify the role played in those transactions by the media--communication structures, processes, techniques, and technologies--through which they are conducted. As a discipline, media ecology is still in its infancy; it has a perspective (ecological) and a wide range of provocative questions, but no systematic framework within which to organize its research. The purpose of this study was to draw on the contributions of seven different disciplines to the study of communication systems, and to formulate on the basis of those contributions an integrated research paradigm for media ecology. Specifically, the study reviews and evaluates, from the perspectives of systems science and media ecology, twelve models of communication developed since 1945 in the fields of mathematics (information theory and cybernetics), sociology, anthropology, psychology, linguistics, semantics, and philosophy, and proposes both an integrated research paradigm for the study of human communication systems and a set of guidelines for the use of the specialized communication models reviewed.

The models selected for review and evaluation were chosen on the basis of the frequency of their citation in the works listed on the bibliographies for introductory college courses in each of the contributing disciplines (i.e., psychology, sociology, anthropology, etc.), and in such communication-related disciplines as studies in mass communication, human relations, and speech. The models selected were those represented in the works of Claude Shannon and Warren Weaver, Norbert Wiener, David Berlo, Bruce Westley and Malcolm MacLean, Jurgen Ruesch and Gregory Bateson, Erving Goffman, Benjamin Lee Whorf and other linguistic anthropologists, Alfred Korzbyski and other

general semanticists, Charles Morris, Charles Fries and other structural linguists, Noam Chomsky, Adelbert Ames and Hadley Cantril, and Thomas Harris and Eric Berne.

As criteria for the review and evaluation of the models selected, the investigator developed two sets of guidelines: systems guidelines and media ecology guidelines. To derive the systems guidelines, the investigator reviewed the literature of general systems theory, identified the philosophical and methodological principles of the systems perspective, presented and explicated these principles in an outline, and derived from the outline a set of questions about the form and functions of any model. To derive the media ecology guidelines the investigator identified, from the responses of faculties in media ecology to a comprehensive bibliography, the "basic literature" of media ecology, reviewed that literature, identified the major principles, hypotheses, subject matter, and questions of media ecologists, presented and explicated these in an outline, and derived from the outline of media ecology a set of questions about the scope and comprehensiveness (relative to the principles and subject matter of media ecology) of any communication model.

Using the systems and media ecology principles as guidelines, the investigator reviewed and evaluated each of the communication models selected. The results are described in a summary which presents, explicates, and identifies the strengths and weaknesses of each model reviewed.

On the basis of the summaries presented, the investigator proposes an integrated research paradigm for the study of human communication systems, which 1) identifies the levels of communication systems which interact in a total communication network, 2) identifies the processing subsystems through which communication takes place, and 3) specifies some of the research questions to which the paradigm leads. Finally, the study proposes a set of guidelines for the use of the specialized communication models reviewed in the investigation.

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CHAPTER I

INTRODUCTION: THE PURPOSE AND CONTEXT OF THE STUDY

It is, by now, almost a commonplace to remark that the twentieth century is an era of change, of change unprecedented in its scope, its pace, and its potential for violent effects on the fabric of civilization. For Kenneth Boulding, the changes which have taken place since 1900 are of such enormous significance that he marks the twentieth century as the turning point in what he calls "the second great transition in the history of mankind"--that is, the transition from "civilization" to "post-civilization."[1] According to Boulding, the impetus for that transition is provided by a radical shift in what he calls man's "image" of reality.[2] Thomas Kuhn refers to the same kind of radical shift as a revolution in paradigms;[3] Pierre Teilhard de Chardin calls it a change in the nöosphere;[4] Ervin Laszlo, Ludwig von Bertalanffy, and others call it simply a shift in

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[1]Kenneth E. Boulding, The Meaning of the 20th Century: The Great Transition, World Perspectives Series, Harper Colophon Books (New York: Harper & Row, Publishers, Inc., 1965), pp. 1-2.

[2]Kenneth E. Boulding, The Image: Knowledge in Life and Society (Ann Arbor, Mich.: The University of Michigan Press, 1956).

[3]Thomas S. Kuhn, The Structure of Scientific Revolutions, Second Edition, Enlarged, International Encyclopedia of Unified Science, II, 2 (Chicago: University of Chicago Press, 1970).

[4]Pierre Teilhard de Chardin, The Phenomenon of Man, Harper Torchbooks (New York: Harper & Row, Publishers, 1960).

man's world view.[1] What each is referring to is an epochal change in the status, organization, and application of knowledge.[2]

One of the consequences of the change to which Boulding and others refer, or, better perhaps, one of its hallmarks, is a movement away from the rigidly compartmentalized, uncoordinated specialization in scientific inquiry which characterized the Newtonian world, and a movement toward increasing integration of both the physical and the social sciences. One of the symptoms of this trend is the proliferation, in recent years, of "compound" disciplines such as mathematical biochemistry, psychobiology, linguistic anthropology, psycholinguistics, and so on. Another is the emergence of new fields of inquiry so broad in their scope that the word "discipline," suggesting as it does some well-bounded area of specialization, scarcely applies to them at all. Rather, they are perspectives, moving perhaps in the direction of metadisciplines. One such perspective, or emerging metadiscipline, is media ecology--broadly defined as the study of complex communication systems as environments.

As a perspective, metadiscipline, or even a field of inquiry, media ecology is very much in its infancy. Media ecologists know, generally, what it is they are interested in--the interactions of communications media, technology, technique, and processes with human feeling, thought, value, and behavior--and they know, too, the kinds of questions about those interactions they are concerned to ask. But media ecologists do not, as yet, have a coherent framework in which to organize their subject matter or their questions.

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[1]See, for example, Ervin Laszlo, The Systems View of the World (New York: George Braziller, Inc., 1972), and Ludwig von Bertalanffy, Robots, Men and Minds: Psychology in the Modern World (New York: George Braziller, Inc., 1967).

[2]Boulding, The Meaning of the 20th Century, pp. 27-40.

Media ecology is, in short, a preparadigmatic science. Like any such science, it has available to it two roads to the development of an integrated conceptual framework or paradigm. One is, of course, to start from scratch--that is, to propose a paradigm of its own invention, then seek justification for it. The other is to examine conceptual frameworks already available from communication-related disciplines such as psychology, sociology, and linguistics, among others, and, using a fallibilist approach, select from those what seems useful and modify or abandon what is not.

The purpose of the present investigation, generally, was to propose one or more paradigms--integrated conceptual models of the communication process--which may prove useful for structuring the inquiries of media ecologists. And the approach taken to the formulation of such paradigms in this study was, generally, a fallibilist rather than a justificationist approach. More specifically, the purpose of the present study was to provide a critical review of selected models of the communication process developed since 1945 in the fields of mathematics (information theory and cybernetics), sociology, anthropology, psychology, linguistics, semantics, and philosophy, and to propose several integrated paradigms suitable for use in structuring the research inquiries of media ecologists into the nature, structure, and effects of communication interactions.

The term "critical review" implies, of course, the existence of some point of view from which the communication models are evaluated. In this investigation, that point of view includes two perspectives: the perspective of media ecology and the perspective associated with a second major meta-discipline, general systems theory. The rationale for integrating the two perspectives, and the need for the study in general, is described on the following pages.

Rationale for the Study

Media Ecology and General Systems Theory: Origins, Significance, and Relationship

Both media ecology and general systems theory have their origins in the twentieth-century change in world view or "image" to which Boulding and others refer. The developments which led to that change are too complex to describe here in detail. Generally, however, they came from three sources: pure science, technology, and philosophy.

In pure science, the twentieth-century revolution in "image" began in 1900 with the publication of Max Planck's Quantum Theory, and was accomplished through de Broglie's and Schrödinger's work in wave mechanics, Heisenberg's Principle of Indeterminacy, and, of course, Einstein's Special and General Theories of Relativity. In a space of less than thirty years, the scientific model of the universe underwent three major transitions: from atomistic to holistic (or systemic), from mechanistic to stochastic, and from deterministic to probabilistic.

In technology, the revolution in "image" came primarily from two sources: on the one hand, the development of information theory, cybernetics, and electronic mass communication systems; on the other, the development of what Herman Kahn calls the "doomsday machine"[1]--a weapons technology with the capability to end all life on earth. Out of the first series of developments came the ability to store, retrieve, and communicate informa-

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[1]Herman Kahn, On Thermonuclear War (Princeton, N.J.: Princeton University Press, 1960).

tion almost instantaneously; thus, the "knowledge explosion." Among other things, the new information technology provided the social sciences with vastly improved methods for "seeing" broad patterns and systems of social behavior, and thus revolutionized the social scientist's "image" of man. Out of the second development--the Bomb--came a revolution in the conduct of political affairs, and an awakening to a whole host of new questions about the role of science and technology in society.

Together, the revolutions in science and technology gave impetus to the renascence, in natural philosophy, of a perspective from which the world could be seen, in A. O. Lovejoy's words, as a "great chain of being." With the support provided by the shift from atomistic to systemic thinking in pure science, ecology emerged, not only as a new natural science in its own right, but as the philosophical world view of all natural science. Moreover, under the impact of a world-shrinking communications technology, and of a weapons technology which explosively demonstrated the connection between science and culture, ecology became the philosophical perspective of the social sciences, as well.

It is out of these three revolutions in the status, organization and application of knowledge that the two broad new disciplines which concern us here--general systems theory and media ecology--have emerged. General systems theory is a product primarily of the revolution in pure science and the ecological perspective; media ecology is a product primarily of the revolution in communications technology and the ecological perspective. Both have in common a view of the world as system, or, in Claude Shannon's phrase, as "organized complexity." Both hold that the key to understanding the organization and complexity of systems lies in the study of the <u>relationships</u> among the components of a system, rather than in the analysis of component composition. Both take as their goal the identification of broad principles which govern the operations of many and diverse systems, and both, therefore, are engaged in a search for new and broader conceptual models and methods of inquiry. In the course of that search, both enlist the aid--the concepts, models, methods, even the personnel--of a wide variety of disciplines, and both are, in that sense, areas of generalization rather than specialization.

The rationale for attempting a rapprochement (admittedly, in a very limited way) between general systems theory and media ecology is not based, however, merely on their similarities; it is based on their differences, as well. One is that, of the two fields, general systems lays claim to the broader scope and purpose. According to its major proponents, general systems theorists are concerned to identify and elucidate principles of systems behavior which apply to all systems--open and closed, steady-state and dynamic, "natural" and "invented," human and non-human. From the general systems point of view, therefore, media ecology--which is concerned primarily with human communication systems and the interaction of technology and culture--is a large sub-discipline within the general systems framework. If that is so, then media ecologists should find only profit, not problems, in applying the principles, concepts, and methods of general systems theorists in their own work. Part of the purpose and significance of this study is that it tests, in a small but meaningful way, the validity of that assumption.

That the assumption is problematic derives from a second difference between general systems and media ecology. Despite its claims to a genuinely interdisciplinary approach and a relevance which is not bounded by the distinctions between natural and social science, general systems theory is heavily influenced by its roots in pure science, and most of its principles and methods have been drawn from the observation of natural systems (e.g., biology, neurology, physics, etc.). Media ecology, on the other hand, is distinctly concerned with human interactions, and most of its models, concepts, and methods have been drawn, to date, from the observation of social systems. It is that very difference which gives the attempt to relate general systems theory and media ecology its potential for methodological productivity. At the same time, however, it raises some serious questions about the extent to which the two systems can be integrated. Lee Thayer points out that,

> In spite of much talk to the contrary, there has been very little exploitation of the potential of general systems theory in the study of communication systems and, indeed, very little systematic interest among general systems theorists and advocates in the study of human communication systems.[1]

What is needed to ameliorate that situation, he goes on to suggest, is a systematic attempt to identify the points at which the philosophy, terminology, concepts, principles, methods, and models of the two disciplines converge and diverge, and where differences can generate productive interaction.[2] While it was not within the scope of the present investigation to carry out that work on a broad scale or in a systematic way, it is part

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[1] Lee Thayer, "Communication Systems," in The Relevance of General Systems Theory, ed. by Ervin Laszlo (New York: George Braziller, Inc., 1972), p. 95.

[2] *Ibid.*, pp. 95-120.

of the significance of the study that it indicates in a tentative way areas in which the concerns, concepts, and methods of media ecologists and general systems theorists converge, and areas in which, at the moment they appear to diverge.

The attempt to relate general systems theory and media ecology in the course of this investigation, therefore, is significant in that it initiates, in some small way, a dialogue between the two disciplines--a dialogue which permits not only the exchange of similar perspectives and mutually useful principles, but one which lays the foundation for future exploration and possible resolution of differences. As Thayer writes, at the end of his brief essay on the relationship between studies in human communication and general systems theory, "I can only conclude that each has much to gain from the other, as they evolve and move toward their respective maturities."[1]

Media Ecology:

The Need for Integrated Paradigms

One difference between general systems theory and media ecology that was not described in the preceding paragraphs, but is relevant to the rationale for the study, is the relative status of the two as organized fields of inquiry. Perhaps because it has its roots in natural science, and natural science has a firmer basis in history for unified and unifying points of view than does social science, general systems theory has progressed

[1] Ibid., p. 121.

far more rapidly toward the status of a discipline than has media ecology. In the twenty-seven years since the near-simultaneous publication, in 1945, of the "founding" works in each field,[1] the term "general systems theory" and its meaning have been fairly well established, in academic discourse, at least. The term "media ecology," on the other hand, has a history of less than four years in the language,[2] and the complex of perspectives and "subjects" it refers to is as yet little understood--in academia or outside of it. General systems theory has traced, recorded in a systematic way, and published the history of its own development;[3] media ecology has not. General systems has its own research foundations, professional organizations and affiliations, established journals; media ecology does not. More important than any of these, general systems has already established at least the beginnings of a taxonomy, a lexicon, a body of research

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[1]In general systems theory, Ludwig von Bertalanffy, "Zu einer allgemeinen Systemlehre," Deutsche Zeitschrift fur Philosophie, 18, No. 3/4 (1945), reprinted in English as "An Outline of General System Theory," British Journal of the Philosophy of Science, I (1950), pp. 139-164; in media ecology, Lewis Mumford, Technics and Civilisation (London: George Routledge & Sons, Ltd., 1945).

[2]The term "media ecology" first appeared in print in 1970, in an article by Neil Postman, "The Reformed English Curriculum," in High School 1980: The Shape of the Future in American Secondary Education, ed. by Alvin C. Eurich (New York: Pitman Publishing Corporation, Inc., 1970), p. 161.

[3]See, for example, Ludwig von Bertalanffy, General Systems Theory: Foundations, Development, Applications (New York: George Braziller, Inc., 1968), pp. 1-17.

methods, a series of clearly articulated principles, and a set of integrated paradigms which all members of the general systems community share. And media ecology has not.

The need for such shared taxonomies, lexicons, and paradigms in the creation and development of a discipline can scarcely be overstated. Without them, you may have a collection of observations, even generalizations, but you do not have a science. As Thomas Kuhn puts it,

> A scientific community is an immensely efficient instrument for solving the problems or puzzles that its paradigms define. Furthermore, the result of solving those problems must inevitably be progress.[1]

To state the necessary relationship between paradigms and scientific communities even more emphatically, Kuhn adds, in the Postscript to his original work:

> A paradigm is what members of a scientific community share, and, conversely, a scientific community consists of men who share a paradigm.[2]

In its present status, then, media ecology cannot be said to be a discipline, or even a scientific community; it is rather, in the words of the final report from the Harvard University Program on Technology and Society, a "problem area."[3] Or, as Gregory Bateson says in the Introduction to Steps to an Ecology of Mind, "It is a science which does not yet exist as an organized body of theory or knowledge."[4] What does exist as a basis from

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[1]Kuhn, Scientific Revolutions, p. 166.

[2]Ibid., p. 176.

[3]Harvard University Program on Technology and Society, 1964-1972, A Final Review (Cambridge, Massachusetts, 1972), p. 2.

[4]Gregory Bateson, Steps to an Ecology of Mind (New York: Ballantine Books, Inc., 1972), p. xv.

which a discipline might be forged is a philosophical perspective, a goal, an extensive list of not-very-well-organized questions, and a rough body of literature which seeks to answer them. What also exists is a vast number of observations and generalizations about human communication, many of them abstracted and codified in models formulated from the specific perspectives, and for the specific purposes, of diverse specialized disciplines--for example, psychology, sociology, linguistics, semantics, and so on. The fact that the work of organizing those observations, generalizations, and models into integrated paradigms has not yet begun, is not a weakness in media ecology, but a source of future strength. For, as J. Bronowski points out, the success of attempts to organize diverse ideas in science depends on their timing:

> A science which orders its thought too early is stifled. . . . A science is a description of the world or, better, a language for describing the world. When a science has been studied as long as astronomy, it can develop a concise description in the shorthand of laws like Newton's. But before this can happen, it must have the observations not only of Tycho Brahe and Keppler, but of the Moors and the Greeks and even the Babylonians. Until a science has passed through a long stage of observation and trial, it cannot develop a system of ordering its observations; and it is sheer presumption to try to do so.[1]

Media ecology has far to go before it attempts to formulate principles on the order of Newton's laws. There is ample evidence, however, that the work of formulating integrated, and integrating, paradigms must be initiated now, if media ecology is to develop as a discipline with the potential for generating, eventually, principles of equal sig-

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[1]J. Bronowski, The Common Sense of Science, A Modern Library Paperback (New York: Random House, Inc., 1959), pp. 47-48.

nificance for the understanding of human communication systems and the interactions of technology and culture. As the report of the Harvard University Program on Technology and Society points out, there are "long-range intellectual problems" underlying current attempts to study such complex interactions, problems that "demand a multidisciplinary approach because of the nature of the subject matter being inquired into."[1] Moreover, the report adds,

> An effective approach to the latter type of problem calls for more than a simple collection of different scholarly viewpoints; what is needed is a genuine blending of the resources and techniques of various disciplines. . . . Truly multidisciplinary methods must be sought, including development of a common language as well as a special effort at intellectual synthesis to focus diverse aspects of the research.[2]

It was the primary purpose of the research reported in this study to initiate that work, and in so doing, to contribute in some small way to the development of media ecology as a discipline.

The Problem

General Statement

The purpose of this investigation was to review and evaluate, from the perspectives of systems theory and media ecology, selected models of the communication process developed since 1945 in the fields of mathematics (information theory and cybernetics), sociology, anthropology, psychology, linguistics, semantics, and philosophy, and to synthesize

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[1]Harvard Program, Final Review, p. 4.

[2]Ibid., pp. 6–7.

from these, where possible, one or several integrated paradigms suitable for use in structuring the research inquiries of media ecologists into the nature, structure, and effects of communication interactions.

Sub-Problems

1. To describe the scientific and philosophical basis for a systems perspective, the principles and concepts which serve as guidelines for a systems science, and the requirements of the systems perspective in regard to conceptual models.

2. To describe the goals of media ecology, the kinds of communication interactions media ecologists are concerned to study, the general questions about communication interactions they seek to answer, and the principles or hypotheses they have already formulated in regard to communication interactions.

3. To select from the models of communication developed since 1945 in the fields of mathematics (information theory and cybernetics), sociology, anthropology, psychology, linguistics, semantics, and philosophy that model or those models which have major significance in each field and demonstrated application, by non-specialists, to aspects of communication outside the discipline of origination.

4. To review and evaluate, from the perspectives of systems theory (as defined in the solution to Sub-Problem 1) and media ecology (as defined in the solution to Sub-Problem 2) the communication models selected in the solution to Sub-Problem 3.

5. To synthesize from the models selected, reviewed, and evaluated, one or several integrated paradigms suitable for use in structuring the research inquiries of media ecologists into the nature, structure, and

effects of communication interactions.

Delimitations

The delimitations of the study applied only to the selection of models (Sub-Problem 3) and are reported, therefore, in Chapter 6 (The Selection of Models).

Assumptions

Since general systems theory and media ecology share a similar goal, a similar philosophical perspective, and similar origins in twentieth-century developments in science, and since media ecology is, from the general systems perspective, a sub-discipline within the broader framework of general systems, it was assumed in this investigation that guidelines for systems models derived from an analysis of general systems science can be validly and productively applied in evaluating models of communication systems.

Definitions

Model

According to Donald MacKay, a model is a member of the class of "representations: structures which have at least some abstract features in common with something else that they purport to represent."[1] According to Randall Harrison, the form of a model may be physical, verbal, pictorial,

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[1]Donald M. MacKay, Information, Mechanism and Meaning (Cambridge, Mass.: M.I.T. Press, 1969), p. 158.

and/or purely symbolic (mathematical).[1] And according to John Keltner, the function of a model is "to provide us with a way to classify and to describe the parts of a process and to indicate how they fit together."[2] Moreover, Keltner adds, "Models may provide clues that permit predictions of behavior and thus may stimulate further research."[3]

For the purpose of this report, then, a model is defined as any representational structure--physical, verbal, pictorial, symbolic, and/or mathematical in form--which has at least some abstract features in common with that which it purports to represent, and which serves to classify, describe, and relate the parts of a process so as to permit predictions of behavior and stimulate further research.[4]

Communication/Communication Process

In a brief paper concerning the definition of communication, S. S. Stevens points out that, "Although no phenomenon is more familiar to us than communication, the fact of the matter is that this magic word means many things to many people. A definition broad enough to encompass all these meanings," he warns, "may risk finding itself dissipated in generalities."[5] Responding to Stevens's paper, Colin Cherry agrees:

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[1]Randall Harrison, "Communication Theory," in Educational Media: Theory into Practice, ed. by Ray V. Wiman and W. C. Meierhenry (New York: Holt, Rinehart and Winston, Inc., 1969), p. 73.

[2]John W. Keltner, Interpersonal Speech Communication: Elements and Structures (Belmont, Cal.: Wadsworth Publishing Company, Inc., 1970), p. 17.

[3]Ibid.

[4]More specific definitions of models of different types, and a review of the literature concerning models in general, are provided in Chapter 2, The Related Literature.

[5]S. S. Stevens, "A Definition of Communication," Journal of the Acoustical Society of America, XXII (November, 1950), p. 689.

"Such definitions or descriptions," he comments, "serve as little more than foci for discussion."[1]

With these warnings well in mind, the investigator found it nonetheless necessary and desirable to adopt, for the purposes of this study, a working definition of communication and the communication process (the two terms are used interchangeably) that is broad, abstract, and inclusive, rather than narrow, concrete, and selective. There are two major reasons for this decision. The first is, as Stevens suggests and other writers categorically assert, that no generally accepted definition of communication currently exists.[2] There is significant disagreement, among authors using the term, concerning not only the nature of communication (e.g., whether it is behavior, event, or relationship), but also its form or structure, its functions, its necessary and sufficient conditions, and its content. There is even significant disagreement concerning who or what engages in communication. Thus, even so broad a definition as that provided by Jurgen Ruesch and Gregory Bateson--"The concept of communication would include all those processes by which people influence one another"[3]--is neither generally accepted nor generally acceptable, because it restricts

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[1]Colin Cherry, On Human Communication: A Review, A Survey, and a Criticism, Studies in Communication (Cambridge, Mass.: Technology Press of Massachusetts Institute of Technology, 1957), p. 6.

[2]John B. Newman, "A Rationale for a Definition of Communication," Journal of Communication, X (1960), p. 115.

[3]Jurgen Ruesch and Gregory Bateson, Communication: The Social Matrix of Psychiatry (New York: W. W. Norton & Company, 1968), p. 6.

the application of the term communication to human interactions. This restriction rules out not only studies of man-machine and machine-machine interactions (which are of some interest to media ecologists), but also inquiries into such phenomena as intrapersonal interactions, microcosmic interactions (e.g., intercellular transmission of information), and animal interactions. Since no less respected a journal than Scientific American recently devoted fully half of its special issue on communication to such studies,[1] any representative definition of communication must be broad enough to include inquiries into non-human as well as human interactions. The first reason, then, why the definition of communication used in this investigation is as broad as possible is that a narrowly circumscribed definition would unjustifiably distort the meanings given the term in both popular and scientific usage, and would misrepresent the scope of agreement among writers working in the field (thus misrepresenting the "state of the discipline").

In many instances, of course, it is possible for a definition to be both broad and concrete, rather than broad and abstract. When the term to be defined is communication, however, the attempt to formulate a broad and concrete definition is, as John Newman points out, both impractical and theoretically unsound. It is impractical, Newman argues, because "communication is so diverse and discursive that the attempt to create a generally accepted definition becomes so profoundly involved that it hinders rather than helps further thought on the subject."[2] And it is

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[1] Scientific American, September, 1972.

[2] Newman, "Definition of Communication," p. 116.

theoretically unsound because "Any attempt to 'completely explain' /the meaning of communication/ can only result in a map so specifically detailed as to be the equivalent of the territory it is intended to represent. Thus, it would not serve the purpose of a map!"[1] The second reason, then, why the definition of communication used in this study is broad and abstract, is that a broad and concrete definition is neither practical nor theoretically sound when the definiendum is communication.

Newman argues, in his essay on defining communication, that what is needed is a meaning for communication "which will permit all persons concerned with communication, regardless of their background, their professional area, or their immediate purposes, to speak intelligibly to one another."[2] In the present writer's opinion, the definition which best serves that purpose, as well as the purposes of this investigation, is a definition proposed by Colin Cherry. In the body of this report, therefore, communication is defined as Cherry defines it in the following passage:

> Perhaps the simplest and broadest definition of the word communication is afforded by this statement: "It is that which links any organism together." Here "organism" may mean two friends in conversation, newspapers and their reading public, a country and its postal service and telephone system. At another level it may relate to a civilization and its culture. When communication ceases, the organism breaks up.[3]

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[1]*Ibid.*, p. 118.

[2]*Ibid.*, p. 123.

[3]Colin Cherry, "The Communication of Information," *American Scientist*, XL (1952), p. 648.

Organism

In common usage, the term organism often connotes a living, as opposed to an inanimate, structure or organization. That connotation, however, is not essential to the definition of the term. According to Webster's New International Dictionary, for example, an organism may be defined as

> Any thing or structure composed of distinct parts and so constituted that the functioning of the parts and their relation to one another is governed by their relation to the whole.[1]

Since that definition corresponds closely with the definition of system used in this report (see below), and since writers in the fields of communication and systems theory often use the terms system and organism interchangeably, organism is used, for the purposes of this study, as a pure synonym for system (as defined below), and its application is not confined to living or animate organizations.

System

For the purposes of this study, a system is defined as any complex entity, composed of interdependent parts, which has properties as a whole that cannot be reduced to the sum of the properties of its component parts. Ervin Laszlo, from whose work the foregoing definition was abstracted,[2] provides the following examples to clarify the concept of a system, and they are cited here for the same purpose:

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[1] Webster's New International Dictionary, 2nd ed., 1934.

[2] Ervin Laszlo, The Systems View of the World (New York: George Braziller, Inc., 1972), pp. 27-29.

> Each constituent of an atom has certain properties. . . , and the atom as a whole has certain properties. And the properties of the atom are not reducible to the properties of all its parts added together. If we took the neutron, proton, and electron of a hydrogen atom and recombined them in an arbitrary way, chances are we would not get a hydrogen atom at all. The properties of the latter equal the properties of all its parts plus the exact relations of the parts within the structure.[1]

The atom, then, is one example of a system. Another is the human brain:

> Even the brain, that most delicate and complex of known organs, is not merely a lot of neutrons added together. While a genius must have more of the gray matter than a sparrow, the idiot may have just as much as the genius. The difference between them must be explained in terms of how those structures are organized. Since the precise correlation of every neuron with every other is more complex than the human brain can comprehend. . . , the brain as a whole, or at least its particular subsystems (hemispheres, areas, or lobes) must be treated as wholes having irreducible properties.[2]

Systems Perspective/Ecological Perspective/Organismic Perspective

The concept of a systems perspective, like the concept of communication, is exceedingly complex and does not lend itself to concise definition. The philosophical and scientific basis for the systems perspective is described in the solution to Sub-Problem 1 of this research (Chapter 3) and the principles of the systems perspective are set out in some detail in Chapter 4. Chapter 4 sets out, in addition, the requirements of the systems perspective in regard to the characteristics and functions of conceptual models. The major work of defining the systems perspective in detail, then, is carried out in Chapter 4, rather than here, and the purpose

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[1] *Ibid.*, p. 31.

[2] *Ibid.*, p. 32.

of the definition provided at this point is merely to establish a general framework for the detailed exposition of the concept provided in a subsequent section of the research report. For that purpose, the systems perspective may be defined, in Ervin Laszlo's terms, as

> . . . a perspective for viewing man and nature. It is a mode of organizing existing findings in reference to the concept of systems and systemic properties and relationships. This means thinking in terms of facts and events in the context of wholes, forming integrated sets with their own properties and relationships. Looking at the world in terms of such sets of integrated relations constitutes the systems view. It is the present and next choice over atomism, mechanism, and uncoordinated specialization.[1]

For the purposes of this study, the terms ecological perspective and organismic perspective are used as synonyms for systems perspective.

Media Ecology

An operational definition of media ecology and media ecologists is provided in the solution to Sub-Problem 2 (Chapter 5). For the purpose of establishing a general framework for the content of Chapter 5, however, the following statement was taken as the working definition of media ecology:

> Media ecology is the study of transactions among people, their messages, and their message systems. More particularly, media ecology studies how media of communication affect human perception, feeling, understanding and value; and how our interaction with media facilitates or impedes our chances for survival. The word ecology implies the study of environments--their structure, content, and impact on people. An environment is, after all, a complex message system which regulates ways of feeling and behaving. It structures what we can see and say and, therefore, do. Sometimes, as in the case of a courtroom, or classroom, or business office, the specifications of the environment are explicit and formal. In the case of

[1] Ibid., p. 19.

> media environments (e.g., books, radio, film, television, etc.), the specifications are more often implicit and informal, half-concealed by our assumption that we are dealing with machines and nothing more. Media ecology tries to make those specifications explicit. It tries to find out what roles media force us to play, how media structure what we are seeing, why media make us feel and act as we do. Media ecology is the study of communications technology as environments.[1]

Contributing Disciplines

Unless otherwise noted, the phrase the contributing disciplines refers exclusively, in this report, to mathematics (information theory and cybernetics), sociology, anthropology, psychology, linguistics, semantics, and philosophy.

Methodology

Sub-Problem 1

> To describe the philosophical and scientific basis for a systems perspective, the principles and concepts which serve as guidelines for a systems science, and the requirements of the systems perspective in regard to conceptual models.

The solution to this sub-problem was intended to serve two purposes. The first was to provide the reader with an overview of the scientific and philosophical context out of which the systems perspective has emerged. Since the goals, principles, concepts, and methods of systems science (including those principles and concepts regarding models) have been very much shaped by its origins in natural science and philosophy, their significance stands out most clearly in the light of an historical perspective. That is

[1]Neil Postman and Charles Weingartner, The Soft Revolution, A Delta Book (New York: Dell Publishing Company, 1971), p. 139.

why providing such a perspective was the first purpose of this sub-problem. The second and major purpose was to provide the investigator with a set of guidelines for the review and evaluation, from a systems point of view, of the communication models selected in Sub-Problem 3.

The data needed for the solution to this sub-problem (i.e., information concerning the scientific and philosophical background of systems science, statements about the principles and concepts of systems theory, and statements about the forms and functions of systems models) were collected from the following sources: 1) the books, General Systems Theory and Robots, Men and Minds, by Ludwig von Bertalanffy; The Systems View of the World and The Relevance of General Systems Theory, by Ervin Laszlo; The Image and The Meaning of the 20th Century, by Kenneth Boulding; and Operational Philosophy and Science and the Goals of Man, by Anatol Rapoport;[1,2] 2) selected books and articles from the bibliographies and references provided in each of the foregoing works; and 3) selected articles published in General Systems, the Yearbook for the Society for General Systems Research.

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[1]Anatol Rapoport, Operational Philosophy: Integrating Knowledge and Action (New York: Harper & Brothers, 1953), and Science and the Goals of Man (New York: Harper & Brothers, 1950).

[2]The works of Laszlo, von Bertalanffy, Boulding, and Rapoport were selected as the basis for the bibliography used in the solution to this sub-problem because Laszlo is the leading exponent of systems philosophy and Editor of the International Library of Systems Theory and Philosophy, and von Bertalanffy, Boulding and Rapoport are co-founders of the Society for General Systems Research. (See von Bertalanffy, General System Theory, pp. 14-15.)

From the information provided in these sources, the investigator, first, constructed a brief description of the scientific and philosophical basis of the systems perspective. That description is provided in Chapter 3 of t' is report.

Next, the investigator identified in that literature 1) the basic presuppositions of the systems perspective, 2) the principles of the systems perspective regarding the definition of system and system properties, 3) the principles of the systems perspective regarding "open" systems and open system properties, and 4) the methodological principles of the systems perspective. The principles in each of the four categories above, definitions of the key terms in each concept, and examples of the applications of each principle, are presented in modified outline form in Chapter 4 of this report.

Finally, the investigator derived from the stated principles of the systems perspective a series of questions for use as guidelines in the review and evaluation of models. Those questions, organized in two categories (questions regarding the form of a model and questions regarding its functions) and keyed to the principles from which they derive, are presented in a list, "Systems Guidelines for the Review and Evaluation of Models," in Chapter 4 of this report.

Sub-Problem 2

> To identify and describe the goals of media ecology, the kinds of communication interactions media ecologists are concerned to study, the general questions about communication interactions they seek to answer, and the principles or hypotheses they have already formulated in regard to communication interactions.

Since the purpose of the present investigation was to formulate integrated paradigms suitable for use in structuring the research inquiries of media ecologists into the nature, structure, and effects of communication systems, the goals, subject matter, questions, communication principles and hypotheses of media ecologists had to be taken into account in reviewing and evaluating the models from which such integrated paradigms were to be constructed. The solution to this sub-problem was intended primarily, therefore, to provide the investigator with a set of guidelines for reviewing and evaluating, from a media ecology point of view, the communication models selected in the solution to Sub-Problem 3. A secondary but nonetheless significant purpose of this sub-problem was to provide the reader, and future investigators, with an operational definition (at least in part) of media ecology as a field of inquiry.

The data needed for the solution to this sub-problem (i.e., information concerning the goals, subject matter, questions, and communication principles or hypotheses of media ecologists) were derived from two sources: 1) descriptions of the goals and content of media ecology as an academic program of studies,[1] written by the members of the faculties of media ecology at New York University, Stanford University, Long Island University, and Jersey City State College,[2] and 2) the works which comprise what might be called the "basic literature" of media ecology. The methodology for identifying the "basic bibliography" for media ecology, and the results of the procedure used, are described in Chapter 5 of this report.

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[1]Sources for the descriptions of the goals and content of media ecology as an academic discipline included college catalogues, student recruitment brochures and printed or mimeographed course descriptions.

[2]These four universities were selected because each offers a program specifically entitled Media Ecology, and their programs have been in effect for at least one year.

From a review of the literature cited in the bibliography for media ecology, and of the goals-and-content statements received from the faculties of media ecology, the investigator constructed a summary of 1) the basic presuppositions and goals of media ecology, 2) the major principles and hypotheses of media ecology, and 3) the subject matter and questions of media ecology. That summary is presented, in modified outline form, in Chapter 5.

Finally, the investigator derived from the statements in the summary of media ecology a series of questions for use as guidelines in the review and evaluation of communication models. Those questions, organized in two categories (questions about the scope of the model and questions about its comprehensiveness) and keyed to the statements in the summary from which they derive, are presented in a list, "Media Ecology Guidelines for the Review and Evaluation of Communication Models," in Chapter 5 of this report.

Sub-Problem 3

> To select from the models of communication developed since 1943 in the fields of mathematics (information theory and cybernetics), sociology, anthropology, psychology, linguistics, semantics, and philosophy that model or those models which have major signficance in each field and demonstrated application, by non-specialists, to aspects of communication outside the discipline of origination.

The solution of this sub-problem was intended to serve two purposes: first, to provide the investigator with a sufficiently limited number of models to ensure that the investigation could be carried out within the time constraints imposed by the context of the study; second, to ensure that the models selected would have intradisciplinary reputability and interdisciplinary relevance.

In the interest of a coherent presentation, and for the convenience of the reader, the description of the procedure used in the selection of communication models are treated together with the results of those procedures, in Chapter 6 of this report.

Sub-Problem 4

> To review and evaluate, from the perspectives of systems theory (as defined in the solution to Sub-Problem 1) and media ecology (as defined in the solution to Sub-Problem 2), the communication models selected in the solution to Sub-Problem 3.

The purposes of the solution to this sub-problem were, first, to provide the reader and future investigators with an explication of the key concepts about communication interactions represented in each model selected for the study, and second, to indicate the strengths and weaknesses, uses and limitations of each model for the study of communication systems.

Each of the communication models selected in the solution to Sub-Problem 3, and the literature relevant to each model, was reviewed by the investigator with special attention to the questions which comprise the media ecology and systems guidelines for models developed in the solution to Sub-Problems 1 and 2. On the basis of the information obtained in that review, the investigator composed for each model a summary which includes 1) representation of the model in the form in which its author(s) present it; 2) explication of key terms, symbols, and concepts in the model; 3) explication of assumptions underlying the model; 4) description of the communication contexts in which the model has been applied; and 5) reference to the strengths and weaknesses of the model in regard to its form, functions, scope, comprehensiveness, and applicability to the communication systems media ecologists are concerned to study.

The results of the review and evaluation of the communication models selected for analysis are presented in Chapter 7 of this report.

Sub-Problem 5

> To synthesize from the models selected, reviewed, and evaluated, one or several integrated paradigms suitable for use in structuring the research inquiries of media ecologists into the nature, structure, and effects of communication interactions.

The solution to this sub-problem was intended to provide media ecologists and other students of communication with integrated conceptual models of the communication process that are broader in scope, more comprehensive in content, and more useful for ogranizing questions and information about a wide variety of communication interactions, than are any of the contributing models in isolation.

The basis for determining which features of which models should be integrated, which features of which models should be deleted, which features should be modified, and what new features should be added to the synthesized paradigms, was the information contained in the summaries of the contributing models. The synthesis was guided, as well, by the information contained in the outlines of the systems perspective and of media ecology developed in the solution to Sub-Problems 1 and 2. Each of the integrated paradigms which resulted is presented and explicated, and the rationale for its design stated, in Chapter 8 of this report.

Chapter Summary

This report is organized in eight chapters. For the convenience of the reader, the content of each chapter is summarized below.

Chapter 1 describes the general purpose of the investigation, explains the rationale and the need for the study, states the problem and the sub-problems of which it is composed, identifies the assumptions underlying the study, defines the key terms in the investigation, and reviews the methodology used in the investigation.

Chapter 2 reviews two bodies of literature related to the investigation: literature which concerns the role of models in scientific method generally, and literature which offers surveys, reviews, and integrations of communication models and theories.

Chapter 3 reviews the developments in science and natural philosophy which serve as the foundations for the systems perspective.

Chapter 4 states and explicates, in modified outline form, the principles of the systems perspective and presents the "Systems Guidelines for the Analysis and Evaluation of Models."

Chapter 5 reviews in brief the history of media ecology; describes the methodology used to identify the "basic literature" of media ecology; lists the works which comprise that literature; describes, in modified outline form, the presuppositions and goals, principles and hypotheses, subject matter and questions of media ecology; and presents the "Media Ecology Guidelines for the Review and Evaluation of Communication Models."

Chapter 6 describes the procedures used in the selection of models and identifies the models selected.

Chapter 7 describes, explicates, reviews, and evaluates each of the communication models selected for analysis.

Chapter 8 presents and explicates the integrated conceptual models of the communication process proposed by the investigator, describes the rationale for each, suggests applications, and offers suggestions for further research.

CHAPTER 2

RELATED LITERATURE

Most of the significant literature related to this investigation is reviewed in the following chapters. The scientific and philosophical background of the systems perspective, and the literature of general systems science, for example, is reviewed in Chapters 3 and 4; the literature of media ecology, in Chapter 5; and the literature related to specific communication models, in Chapter 7. There are, however, two additional bodies of literature which are not reviewed in subsequent chapters, but which form part of the context of the investigation and deserve brief mention here. One concerns the role of models in scientific inquiry generally, and the other is comprised of existing works on communication models.

The Role of Models in Scientific Method

The forms and functions of models and model-building in scientific inquiry is the subject of an extensive literature, and some aspects of model theory are the subject of intensive debate among philosophers of science, as well.[1] Although the literature on model theory dates as far

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[1] Mary B. Hesse, Models and Analogies in Science (Notre Dame, Ind.: University of Notre Dame Press, 1966), p. 1.

back as Aristotle and Cicero,[1] discussion on the subject began in earnest in the first quarter of the twentieth century, with the publication of Pierre Duhem's attack on the use of theoretical models, in La Théorie Physique, in 1914, and of N. R. Campbell's response to Duhem, in Physics, The Elements, in 1920.[2] In the forty years following the publication of Campbell's work, references to "models," "analogues," "homologues," "metaphors," and related terms proliferated in scientific research and, as they did, the philosophical debate on the meaning of such terms and the functions of their referents became more profuse, more heated, and more confused, reaching its peak in 1960, when, at the International Congress for Logic, Methodology, and Philosophy of Science, almost half the papers presented concerned models, model theory, or closely related issues.[3] Towards the end of that Congress, Yuen Ren Chao illustrated, in his paper "Models in Linguistics and Models in General," the semantic confusion engendered by the fifty or more disparate usages, in the papers presented, of the term "model," and issued an appeal for, first, clarification of the terminology related to models, and second, clarifica-

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[1] Max Black, Models and Metaphors (Ithaca, N.Y.: Cornell University Press, 1962), n. 11, p. 34.

[2] Hesse, Models and Analogies, pp. 1-3. For a summary of Duhem's and Campbell's positions on models, see infra, pp. 37-40.

[3] Ernest Nagel, Patrick Suppes, and Alfred Tarski, eds., Logic, Methodology and Philosophy of Science: Proceedings of the 1960 International Congress (Stanford, California: Stanford University Press, 1962).

tion of the philosophical issues in debate.[1] Since then, the most significant works in models and model theory have addressed themselves to those goals. The authors most frequently cited in contemporary references to model theory are Max Black, Mary B. Hesse, Abraham Kaplan, and Karl Deutsch.[2] For the sake of convenience here, Black's work will be taken as representative of attempts to establish definitions in model theory, Hesse's work will be taken as representative of attempts to clarify philosophical issues, and similar and dissimilar treatments of the same subjects will be referred to in footnotes.

In Models and Metaphors, Black distinguishes between three classes of representations: metaphors, models, and archetypes. A metaphor, according to Black, is a comparison between things alike in some respects but different in most, which

> . . . has the power to bring two separate domains into cognitive and emotional relation by using language directly appropriate to the one as a lens for seeing the other; the implications, suggestions, and supporting values entwined with the literal use of the metaphorical expression enable us to see a new subject in a new way.[3]

Scientific models and metaphors are alike in that both require "analogical transfer of a vocabulary. Metaphor and model making reveal new relationships: both are attempts to pour new content into old bottles." They are different in that "A metaphor operates with largely commonplace

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[1]Yuen Ren Chao, "Models in Linguistics and Models in General," in Nagel, et al., Logic, Methodology and Philosophy, pp. 558-566.

[2]Black, Models and Metaphors; Hesse, Models and Analogies; Abraham Kaplan, The Conduct of Inquiry (San Francisco: Chandler Publishing Company, 1964); Karl Deutsch, "On Communication Models in the Social Sciences," Public Opinion Quarterly, XVI (1952), pp. 356-80.

[3]Black, Models and Metaphors, p. 236.

implications. You need only proverbial knowledge, as it were, to have your metaphor understood."[1] In a model, on the other hand, "systemic complexity of the source of the model and capacity for analogical development are of the essence."[2] Black concludes his analysis of metaphor with the observation that "The term 'metaphor' is best restricted to relatively brief statements, and if we wish to draw upon the traditional terms of rhetoric, we might better compare the use of models with allegory."[3,4]

Models, according to Black, may be divided into four classes: scale models (or icons), analogue models, mathematical models, and theoretical models. By scale models or icons, Black means "All likenesses of material objects, systems, or processes, whether real or imaginary, that preserve relational properties."[5,6] The distinguishing characteristic of scale models is that they "resemble the original by reproduction of some features (e.g., in a scale model of a ship, the color

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[1] Ibid., pp. 238-239.

[2] Ibid., p. 239.

[3] Ibid.

[4] Kaplan deals with the metaphor/model relationship in a similar way in the Conduct of Inquiry, pp. 265-266.

[5] Black, Models and Metaphors, p. 220.

[6] Kaplan calls these physical models and says much the same of them as Black does, in the Conduct of Inquiry, pp. 266-267, 273.

of the ship's hull and the shape and rigidity of the airfoil) and, on the other hand . . . the preservation of the relative proportions between relevant magnitudes."[1] The primary use of a scale model is to permit prediction of the effects of specific manipulations on the original of the model by manipulating the corresponding properties of the scale model.[2] The major disadvantage of the scale model is that the very change in proportion from the original to the model "must inevitably introduce irrelevance and distortion."[3]

An analogue model, according to Black, is "some material object, system, or process designed to reproduce as faithfully as possible in some new medium the structure or web of relationships in the original."[4] The significant difference between a scale model and an analogue model is that, while the former reproduces the characteristics of the original, with a change in the magnitude of proportions, the latter reproduces only the structure of the original. Thus, as Black points out, "The dominating principle of the analogue model is what mathematicians call 'isomorphism' . . . a point by point correspondence between the relations it embodies

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[1]Black, Models and Metaphors, p. 22.

[2]Black, Models and Metaphors, p. 221.

[3]Ibid.

[4]Ibid., p. 222.

and those embodied in the original."[1,2] Summarizing the strengths and weaknesses of analogue models, Black notes that

> The remarkable fact that the same pattern of relationships, the same structure, can be embodied in an endless variety of different media makes a powerful and dangerous thing of the analogue model. The risks of fallacious inference from inevitable irrelevancies and distortions in the model are now present in aggravated measure. Any would-be scientific use of an analogue model demands independent confirmation. Analogue models furnish plausible hypotheses, not proofs."[3]

The mathematical model, as its label suggests, is a representation in mathematical formula of certain processes and relationships within a field.[4] Black identifies three concepts associated with mathematical models:

> The original field is thought of as "projected" upon the abstract domain of sets, functions, and the like that is the subject matter of the correlated mathematical theory; thus social forces are said to be "modeled" by relations between mathemathematical entities. The "model" is conceived to be simpler and more abstract than the original. Often there is a suggestion of the model's being a kind of ethereal analogue model, as if the mathematical equations referred to an invisible mechanism whose operation illustrates or even partially explains the operation of the original system under investigation. This last suggestion must be rejected as an illusion.[5]

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[1] Ibid.

[2] Kaplan offers a more extended discussion of isomorphism in The Conduct of Inquiry, pp. 263-264.

[3] Black, Models and Metaphors, p. 223.

[4] Kaplan deals only briefly with mathematical models, which he classifies as "symbolic, postulational, and formal models," in The Conduct of Inquiry, pp. 260-262. A more extensive review of the forms, functions, and processes of mathematical modeling is provided in D. J. Bartholomew and E. E. Bassett, Let's Look at the Figures: The Quantitative Approach to Human Affairs (Harmondsworth, England: Pelican Books, Ltd., 1971).

[5] Black, Models and Metaphors, p. 223.

The advantages of mathematical models, according to Black, include "precision in formulating relationships, ease of inference via mathematical calculation, and intuitive grasp of the structures revealed (e.g., the emergence of the 'logistic function' as an organizing and mnemonic device)."[1] But, he adds,

> The attendant dangers are equally obvious. The drastic simplifications demanded for success of the mathematical analysis entail a serious risk of confusing accuracy of mathematics with strength of empirical verification in the original field. Especially important is it to remember that the mathematical treatment furnishes no _explanations_. . . . _Causal_ explanations must be sought elsewhere."[2]

Black defines the concept of a _theoretical model_ operationally, as follows:

> 1. We have an original field of investigation in which _some_ facts and regularities have been established (in any form, ranging from disconnected items and crude generalization to precise laws, possibly organized by a relatively well-articulated theory).
> 2. A need is felt, either for explaining the given facts and regularities, or for understanding the basic terms applying to the original domain, or for connecting it with hitherto disparate bodies of knowledge--in short, a need is felt for further scientific mastery of the original domain.
> 3. We describe some entities (objects, materials, mechanisms, systems, structures) belonging to a relatively unproblematic, more familiar, or better-organized domain. The postulated properties of these entities are described in whatever detail seems likely to prove profitable.
> 4. Explicit or implicit rules of correlation are available for translating statements about the secondary field into corresponding statements about the original field.
> 5. Inferences from the assumptions made in the secondary field are translated by means of the rules of correlation and then independently checked against known or predicted data in the primary domain.[3]

As Black points out, the relations between a theoretical model and the

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[1] _Ibid._, p. 225.

[2] _Ibid._

[3] _Ibid._, p. 230.

original domain are almost the same as those between an analogue model and its original. The significant difference, according to Black, is that scale models and analogue models must actually be put together. "But theoretical models," he notes, "are not literally constructed: the heart of the method consists in <u>talking</u> in a certain way."[1] This characteristic gives the theoretical model certain distinct advantages over analogue models, but also introduces certain risks. As Black points out:

> The theoretical model need not be built; it is enough that it be described. But freedom to describe has its own liabilities. The inventor of a theoretical model is undistracted by accidental and irrelevant properties of the model object, which must have just the properties he assigns to it; but he is deprived of the controls enforced by the attempt at actual construction.[2]

It is the use of theoretical models that has occasioned the greatest disagreement among philosophers of science in the past, and, to some extent, the argument persists--in somewhat modifed form--among some philosophers to date. The outlines of the debate, as noted earlier, were laid down by Pierre Duhem and N. R. Campbell at the beginning of the twentieth century. According to Mary Hesse,

> . . . Duhem contrasted /in La Théorie Physique/ two kinds of scientific mind. . . : on the one hand, the abstract, logical, systematizing, geometric mind typical of Continental physicists, on the other, the visualizing, imaginative, incoherent mind typical of the English. . . . Correspondingly, Duhem distinguished two kinds of theory in physics; the abstract and systematic on the one hand, and on the other, theories using familiar mechanical models.[3]

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[1] <u>Ibid</u>., p. 229.

[2] <u>Ibid</u>.

[3] Hesse, <u>Models and Analogies</u>, pp. 1-2.

The following two passages from La Théorie Physique serve to illustrate the contrast, as Duhem saw it:

> The whole theory of electrostatics constitutes a group of abstract ideas and general propositions, formulated in the clear and precise language of geometry and algebra, and connected with one another by the rules of strict logic. This whole fully satisfies the reason for a French physicist and his taste for clarity, simplicity, and order. . . .[1]

> Theory is for him /the English physicist/ neither an explanation nor a rational classification, but a model of these laws, a model not built for the satisfying of reason but for the pleasure of the imagination. Hence, it escapes the domination of logic.[2]

In Duhem's view, models serve only two possible functions in science. The first, which Duhem admits has some value, is to provide a shortcut to demonstrating analogical correspondence between two domains which have already been formulated as abstract systems.[3] (Even then, Duhem argues, "the demonstration of an exact correspondence will involve nothing that can astonish the most rigorous logician.")[4] The second, which he views with frank contempt, is to provide a psychological crutch in the development of theory for those whose minds are not well-ordered

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[1]Pierre Duhem, The Aim and Structure of Physical Theory, translated by Philip P. Wiener (Princeton: Princeton University Press, 1954), p. 61, cited by Hesse, Models and Analogies, p. 2.

[2]Duhem, Physical Theory, p. 81, cited by Black, Models and Metaphors, p. 234.

[3]Black, Models and Metaphors, p. 234.

[4]Duhem, Physical Theory, p. 97, cited by Black, Models and Metaphors., p. 234.

enough to cope with the purely logical process of reasoning deductively from hypotheses.[1]

Duhem's views were directly challenged by N. R. Campbell, who took the position, in Physics, The Elements, that models are not a mere aid to the development of theory, but an absolute essential.[2] According to Hesse, Campbell's position is based on two major arguments, which she summarizes as follows:

> First, he considers that we require to be intellectually satisfied by a theory if it is to be an explanation of phenomena, and this satisfaction implies that the theory has an intelligible interpretation in terms of a model, as well as having mere mathematical intelligibility and perhaps the formal characteristics of simplicity and economy. The second and more telling argument presupposes the dynamic character of theories. A theory in its scientific context is not a museum piece, but is always being extended and modified to account for new phenomena. Campbell shows in terms of the development of the kinetic theory of gases how the billiard-ball model of this theory played an important part in its extension, and he argues perceptively that, without the analogy with a model, any such extensions will be merely arbitrary. Moreover, without a model, it will be impossible to use a theory for one of the essential purposes we demand of it, namely, to made predictions in new domains of phenomena.[3]

Campbell's position, therefore, is that, in his own words:

> . . . analogies are not "aids" to the establishment of theories; they are an utterly essential part of theories, without which theories would be completely valueless and unworthy of the name. It is sometimes suggested that the analogy leads to the formulation of the theory, but that once the theory is formulated the analogy has served its purpose and may be removed or forgotten. Such a

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[1]Black, Models and Metaphors, p. 235.

[2]Hesse, Models and Analogies, p. 3.

[3]Hesse, Models and Analogies, p. 5.

suggestion is absolutely false and perniciously misleading.[1]

There, in brief, is the heart of the argument about the functions of models in scientific methodology. As Mary Hesse points out, "the debate has not been decisively closed."[2] Nor has it been, apparently, an obstacle to the use of models in many forms and for many purposes in current investigations in almost every discipline. In practice, most investigators seem to accept the view of models expressed by Karl Deutsch:

> By a model is meant a structure of symbols and operating rules which is supposed to match a set of relevant points in an existing structure or process. Models of this kind are indispensable for the understanding of complex processes. The only alternative to their use would be an attempt to "grasp directly" the structure or process to be understood; that is to say, to match it completely, point for point. This is manifestly impossible.[3]

For practical purposes, that is the general view toward models taken in this investigation.

Communication Models: Surveys, Reviews, and Integrations

Most of the existing literature directly concerned with communication models, theory, and research is comprised of surveys, from an historical or critical point of view, of the models and theories available in the contributing disciplines. Colin Cherry's book, On Human Communication, for example, reviews the theoretical contributions, from roughly 1920 through 1959, of linguistics, semantics, mathematics, psychology,

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[1]N. R. Campbell, Physics, The Elements (Cambridge: 1920), p. 129, cited by Hesse, Models and Analogies, pp. 4-5.

[2]Hesse, Models and Analogies, p. 5.

[3]Deutsch, "Models in the Social Sciences," pp. 357-358.

and phonetics to the study of communication.[1] Cherry's work is more than a recapitulation, in the sense that he attempts to point out the historical and logical relationships between one discipline and another, but it does not attempt a synthesis or unification of communication theories as a whole. In his own brief review of research in communication, John B. Carroll cites Cherry's work as the most useful source book available (in 1958) to those in education who would understand the basis for an evolving science of communication.[2]

In a somewhat later survey (1961), F. Craig Johnson and George R. Klare reproduce and review in the briefest possible fashion eleven diagrammatic models of the communication process developed in the years 1950 to 1960. Included in their survey are the Carroll, Schramm, Osgood, Richards, Pierce, Whatmough, Ruesch and Bateson, Newcomb, Westley and MacLean, and Gerbner models. Apart from their two conclusions--that diagrammatic models seem to be the preferred form for describing the communication process, and that the Shannon-Weaver model had a strong influence on later models--Johnson and Klare made no comment on the models themselves.[3] In a more recent review of the same material, however, Randall Harrison gives more attention to the relationships among the models Johnson and Klare recapitulate, in an effort to demonstrate the

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[1]Cherry, On Human Communication (Cambridge: M.I.T. Press, 1957).

[2]John B. Carroll, "Communication Theory, Linguistics, and Psycholinguistics," Review of Educational Research, XXVIII (1958), pp. 79-80.

[3]F. Craig Johnson and George R. Klare, "General Models of Communication Research," Journal of Communication, XI (1961), pp. 13-26.

gradual evolution, in communication theory, of more and more complex and integrated models. Harrison concludes, on the basis of the models examined, that gradual progress toward increasingly sophisticated models of communication has been made, but that much remains to be done in the achievement of a unified theory or model of the communication process.[1]

In addition to the surveys or reviews such as those described above, the literature on communication research includes several compilations of selected theoretical papers on the communication process, representing a wide variety of disciplines. The two most notable and widely cited early works of this kind are Communication: Theory and Research[2] and Communication: Concepts and Perspectives.[3] The works contain the papers presented at, respectively, the First and Second International Symposia on Communication Theory and Research, and reflect the theoretical and practical concerns (in 1965 and 1966) of scholars in such communication-related fields as linguistics, social psychology, literary theory, physics, neurophysiology, information technology, and others. While no attempt is made to organize or integrate the various presentations so as to illustrate agreement or disagreement in communication research, the books are valuable sources of information concerning the theoretical perspectives from which many communication models derive.

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[1]Harrison, "Communication Theory," pp. 73-97.

[2]Lee Thayer, ed., Communication: Theory and Research: Proceedings of the First International Symposium (Springfield, Ill.: Charles C. Thomas, Publisher, 1967).

[3]Lee Thayer, ed., Communication: Concepts and Perspectives: Proceedings of the Second International Symposium (Washington: Spartan Books, 1967).

A more recent publication of the same type, but composed almost entirely of abstracts or modified versions of previously published papers, is Communication and Culture.[1] Unlike the two works cited above, Communication and Culture provides, in addition to the readings, valuable direction to the student of communication theory and models by suggesting, in its own organization, a classification of theoretical contributions into categories originally proposed by Charles Morris: problems in syntactics, problems in semantics, and problems in pragmatics.[2]

Not all surveys of communication models and theory are as broad in scope as those compiled by Smith and Thayer; some notable reviews focus on the models offered in a particular area of communication studies. In Speech-Communication: Theories and Models and Theories of Mass Communication, to cite two examples, Raymond Smith and Melvin De Fleur provide historical perspectives on the evolution of theories and models in speech and mass communication, respectively, and suggest directions in which future theoretical work might move, if increasing unity of communication theory is to be achieved.[3]

As many of the works already cited here suggest, the history of communication theory reveals a pattern of increasing theoretical

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[1]Alfred G. Smith, Communication and Culture (New York: Holt, Rinehart and Winston, Inc., 1966).

[2]Ibid., "Introduction: Communication and Culture," pp. 1-7.

[3]Raymond G. Smith, Speech-Communication: Theory and Models (New York: Harper & Row, Publishers, Inc., 1970); Melvin De Fleur Theories of Mass Communication (New York: David McKay Company, Inc., 1966).

synthesis and integration, with each succesive model incorporating the most reliable and productive features of earlier models in an attempt to formulate generalizations at higher and higher orders of abstraction and application. To date, the highest order of generalization achieved in communication models has been at what might be called the "problem area" or "disciplinary" level. Four models, in particular, represent attempts at extensive synthesis of preceding works at the "problem area" level. In the earliest such effort, Franklin Fearing proposes a "broad conceptual framework within which the how and why of human loquacity may be considered" from the perspective of interpersonal psychology. Fearing draws primarily on the work of "field" psychologists such as Kurt Lewin and "perceptual" psychologists such as Hadley Cantril to construct "a frame of reference for human communication behavior which places it in the context of personality-perceptual theory."[1]

Bruce Westley and Malcolm MacLean follow Fearing's lead, and even borrow some of the concepts from his model, to construct "a conceptual model for communications research" in a different "problem area"--mass communications. Their model, based primarily on adaptations of concepts from interpersonal psychology (T. M. Newcomb's concept of roles and norms), cybernetics (Wiener's "feedback" concept), field psychology (Kurt Lewin's notion of a "gatekeeper"), and information theory (the "encoder" concept from C. R. Bush's adaptation of Shannon and Weaver's model), is designed

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[1]Franklin Fearing, "Toward a Psychological Theory of Human Communication," Journal of Personality, XXII (1953), pp. 71-87.

to provide an integrated paradigm which can serve the research interests of mass communications specialists in particular.[1]

George Gerbner's "general model of communication" is designed for still another purpose: to organize and categorize the different areas of interest in communication research (as of 1956), and to show how they may be related to one another. Gerbner's model, perhaps the broadest overview of communication studies to date, is offered primarily as a model of "the structure of the discipline" (as he sees it), rather than a model of the communication process, although Gerbner bases his disciplinary model on a review of theoretical contributions to the description of communication as a process.[2]

Perhaps most representative of the efforts at integrated model building to date is the work of Gardner Murphy and Bess Sondel, who have proposed a "field theory of human communication" which represents the communication process from the perspective of general semantics. Following the suggestion made by Elwood Murray that understanding of the communication process might be extended through the use of analogue models, and, in particular, models based on analogies with cybernetics and general semantics,[3] Murphy and Sondel attempt to integrate the work

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[1]Bruce H. Westley and Malcolm S. MacLean, Jr., "A Conceptual Model for Communication Research," Audio-Visual Communication Review, III (Winter, 1955), pp. 3-12.

[2]George Gerbner, "Toward a General Model of Communication," Audio-Visual Communication Review, IV (Summer, 1956), pp. 171-199.

[3]Elwood Murray, "Future Directions in Communication Research: An Assessment of the Possible Use of Analogues," Journal of Communication, XI (1961), pp. 3-12, 33.

of such semanticists as Charles Morris, C. K. Ogden, I. A. Richards, and Alfred Korzybski, and propose a model which they hope may serve not only to illustrate the meaning-making process in particular, but also to direct, by analogical application, the study of communication in general.[1]

In the light of the foregoing review of the literature related to communication models, the present investigation may be viewed in two ways. First, it represents an attempt to provide, in the tradition of Fearing, Westley and MacLean, and Sondel and Murphy, an integrated model, at the "problem area" level, for still another field of communication research--media ecology. But since media ecology has, of all the communication studies, the broadest scope and perspective on communication, the investigation also represents an attempt to achieve synthesis at a level one step higher than perviously attempted--the multidisciplinary level--and one step closer to the goal of a unified communication theory.

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[1]Gardner Murphy, "Toward a Field Theory of Communication," Journal of Communication, XI (1961), pp. 196-201; Bess Selzer Sondel, The Humanity of Words (New York: The World Publishing Company, 1958).

CHAPTER 3

THE SYSTEMS PERSPECTIVE:

SCIENTIFIC AND PHILOSOPHICAL BACKGROUND

> There is no theory without an underlying world view which directs the attention of the scientist. There is no experiment without a hypothesis and no science without some expectation as to the nature of its subject matter. The underlying hypotheses guide theory formulation and experimentation, and they are in turn specified by the results of the experiments designed to test the theories. The problem, both for science and for the widest communities of concerned persons, is to explicate this implicit natural philosophy of the contemporary sciences.
>
> Ervin Laszlo
> The Systems View of the World[1]

The purpose of the chapter following this, like the purpose of Ervin Laszlo's book, is to explicate (albeit in far less detail than Laszlo provides) the key principles of the emerging world view known as the "systems perspective," and to formulate from those principles a set of guidelines for the analysis and evaluation of systems models. There is little point in addressing that purpose, however, until the rationale for adopting a "systems perspective" on the world has been made clear. To elucidate that rationale, it is necessary to review briefly the scientific and philosophical context out of which the systems perspective

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[1]Ervin Laszlo, The Systems View of the World (New York: George Braziller, Inc., 1972), pp. vi-vii.

has emerged as what Ludwig von Bertalanffy has called "the new natural philosophy" of the physical and social sciences.[1] The present chapter, therefore, is intended to provide the reader with a brief overview of the "old natural philosophy" of science (the Newtonian world view), of the developments in 20th-century physics and biology which called that world view into question, and of the foundations in natural science on which the new view of the world as system rests.

The Newtonian Universe: The World as Machine

For roughly three full centuries (1600-1900), almost all science and natural philosophy derived from the work of one man: Isaac Newton. Newton did not, to be sure, stand alone as the architect of the clockwork universe. Long before he had articulated the universal laws governing the movement of bodies at a distance, and even before Galileo had formulated his principles regarding the movement of heavenly bodies, Francis Bacon had proposed the reduction of all events in the physical universe to matter and motion, and had developed the empiricist methodology on which Newtonian science would heavily rely. Before Newton, Galileo had taken the methodology of science beyond pure empiricism to hypothetico-empiricism, had intimated the exclusion of sense-modulated perceptions from the "real" world of science, and had proposed the principles of classical mechanics regarding the motion of heavenly bodies which would

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[1]Ludwig von Bertalanffy, Robots, Men and Minds (New York: George Braziller, Inc., 1967), p. 53.

serve as essential building blocks in the universe that both Descartes and, later, Newton, would construct. And finally, before Newton, Descartes had already had his nocturnal vision (the basis for his Discourse on Reason) of the "universal mechanics" that would reduce the world and all the events and phenomena in it to the ultimate and objective "realities" of extension (or space) and motion, in interactions governed by laws arrived at through purely rational deduction and revealed in mathematics.

It remained for Newton and Newton alone, however, to combine the empiricism of Bacon, the deductive reasoning and mathematics of Descartes, and the principles of classical mechanics developed by Galileo, and apply them in the formulation of an answer to a new question about bodies in motion: not how do masses in motion behave, but what causes masses in motion to behave as they do. It is that question, the answer to it, and the picture of the universe derived from the answer, that constitutes not only Newtonian physics but the metaphysics which has come to be known as the Newtonian world view.

Perhaps the most concise description, both of Newton's methodology as a scientist and of the picture of the universe he constructed, is provided by the following passage from J. Bronowski:

> What Newton did was to take from the experiments of Galileo and other Italians some general notions of how masses behave: that they travel in straight lines and at a uniform pace, that they go on traveling so unless a force displaces them, and so on. So far, the method may be called deductive, because it rests fairly closely on experiment; although even here deduction does not give quite the right picture of the method, which calls for a great deal of mental experiment in building up possible worlds from different laws.

> But it is at the next step that the break really comes. What Newton did now was to suppose that the general rules which fair-sized masses seem to obey are true of every piece of matter, whatever its kind or its size. And having decided to try this thought, he made himself a new world of his own, which he built up from minute pieces of matter, each following the same laws or axioms. . . .
> . . . .
> Newton then built up his world of unknown small particles assembled in such masses as the apple, the moon, the planets and the sun. Each of these assemblies is alike in his view in being made up of these minute pieces of matter. And in each of them the minute pieces obey the same laws: if they are at rest then they remain at rest, or if they are moving they go on moving steadily in straight lines, until they are displaced by outside forces. And greatest among these forces is this, that each minute particle in Newton's world attracts every other equal particle with a force which depends only on their distance apart, falling off in such a way that when the distance is doubled, the force shrinks to a quarter.
> And this is only the first step. Newton went on to show that as a result of this, the orbits of the planets can be calculated; that they are the ellipses which Kepler had measured; and that they remain stable paths turning like a divine clockwork. He went on to calculate the tides and the paths of comets; and so he slowly built up a picture of the world which is recognizably the world as the mariner sees it, and the astronomer, and the picnickers on Brighton Beach. . . . And it is this success which gives us our faith in the substratum of tiny particles each obeying the laws on which Newton's picture is built. This assumption under the picture, this faith in a minute substratum has had important consequences in shaping our methods and our metaphysic every since.[1]

The essence of the Newtonian world view lies in three of its principles, the validity of which Newton's physics was held to establish beyond question. The first has to do with the exclusion from nature, or at least from the scientific description of nature, of the notion of "cause" in its purposive or goal-oriented sense. In the Newtonian view, "cause" simply expresses the experimentally or mathematically determined relationship between events, a relationship such that, "given a definite configuration of wholly material things, there will always follow upon

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[1]J. Bronowski, The Common Sense of Science, Modern Library Paperbacks (New York: Random House, 1959), pp. 35-38.

it the same observable event. If we repeat the same configuration, we shall always get the same event following it."[1] The second principle is that nature is always regular and uniform. And the third principle, which follows from the first two, is that the laws which govern the operations of some bodies must universally govern the operations of all bodies. Newton sets forth these principles, and the consequences to which they lead, at the beginning of Book III of the _Philosophiae naturalis principia mathematica_, under the heading "Rules of Reasoning in Philosophy":

> _Rule I_. We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances.
>
> Philosophers assert that nature does nothing in vain, and more is in vain whenever less will serve. Nature is pleased with simplicity and affects not the pomp of superfluous causes.
>
> _Rule II_. Therefore, whenever possible, we must ascribe the same natural effects to the same causes.
>
> This applies to respiration in man and beast, the fall of stones in Europe and America, the light of our kitchen fire and the sun, the reflection of light by the earth and the planets.
>
> _Rule III_. The qualities of bodies which admit neither intension nor remission of degrees, and which are found to belong to all bodies within the reach of our experiments, are to be esteemed the universal qualities of all bodies whatsoever.
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> . . . The bodies which we handle we find impenetrable, and thence conclude impenetrability to be an universal property of all bodies whatsoever. That all bodies are movable, and endowed with certain powers (which we call the force of inertia) of persevering in their motions, or in their rest, we infer from the like properties observed in the bodies which we have seen. The extension, hardness, impenetrability, mobility and force of inertia of the whole, result from the extension, hardness, impenetrability, mobility and force of inertia of the parts; and thence we conclude the least particles of all bodies to be also extended, and hard and impenetrable and movable and endowed with their forces of inertia. And this is the foundation

[1] _Ibid._, p. 41.

of natural philosophy.[1]

Out of the causality, uniformity, and atomistic reductionism of Newtonian physics came two additional principles of the Newtonian world view: determinism and certainty. For, if the laws governing the behavior of bodies in motion were established, and if nature were uniform, and if every material ojbect were composed of smaller bodies sharing the properties of the whole and following the same laws of motion, then all the operations of the physical world in the future could be determined, in theory at least, with absolute certainty from the configurations of the parts in the present. Hence, the view of the universe--or at least of the physical universe--as clockwork machine: perfectly symmetrical, absolutely precise, and, in principle, fully knowable as objective reality in which no human intervention could alter its working in the least.

The full significance of Newtonian physics did not lie, however, merely in its consequences for the study of the material universe. While Newton himself, and even Descartes, took care to confine the principles of mechanism, atomistic reductionism, causality, and determinacy to the explanation of the physical world, their 18th-century successors in philosophy, and their 19th-century counterparts in the natural and emerging social sciences, were not so wary. Thomas Hobbes, for example, attacked Descartes on the grounds that he had not been mechanistic enough. If the operations of the planets and stars, the seas, and all the material

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[1]Isaac Newton, Philosophiae naturalis principia mathematica, Book III, 1687, trans. by Motte, cited by Werner Heisenberg, The Physicist's Conception of Nature, trans. by Arnold J. Pomerans (New York: Harcourt, Brace and Company, 1958), pp. 115-118.

objects in the universe could be explained solely and adequately in terms of body and motion, Hobbes argued, it would be arbitrary to draw the line at the operations of human mind and thought. Mind and thought, Hobbes declared, no less than any other human activity, were reducible to the motions of masses: "If this be so, reasoning will depend on names, names on the imagination, and imagination, perchance, as I think, on the motion of the corporeal organs. Thus mind will be nothing but the motions in certain parts of an organic body."[1]

In England, on the Continent, and in Holland, the mechanistic view found support and extension in the philosophy of Locke, Voltaire, d'Alembert, and Spinoza, and in the "social mathematics" of John de Witt.[2] At the midpoint of the 18th-century, La Mettrie was asserting that

> If I am granted that organized matter is endowed with the principle of motion, which alone distinguishes it from the unorganized (and who could doubt this in the face of so much incontrovertible observation), and that in animals everything depends on this organization as I have already proved at length, this will suffice for solving the puzzle of substances and of man. It is clear that there is but one substance in the world, and that man is its ultimate expression. Compared to monkeys and the cleverest of animals, he is just as Huygens' planet clock is to a watch of King Julian. If more wheels and springs are needed to show the motion of the planets than are required for showing and repeating the hours, and if Vaucanson needed more artistry in producing a flautist than a duck, his art would be harder put to produce a "talker"; but such a machine. . . must no longer be thought of as impossible.[3]

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[1]Thomas Hobbes, Leviathan (New York: Oxford University Press, 1947), cited by Floyd Matson, The Broken Image: Man, Science and Society, Anchor Books (Garden City, N.Y.: Doubleday & Company, Inc., 1966), pp. 6–7.

[2]Matson, The Broken Image, pp. 7-9.

[3]Julien Offray de La Mettrie, L'Homme machine (Man as a Machine), 1748, cited by Werner Heisenberg, The Physicist's Conception of Nature, pp. 135-137.

And by the end of the same century, Laplace was proclaiming his vision of achieving perfect prediction, exact measurement, and absolute certainty in all the sciences of nature, of life, and of man. A superhuman Intelligence, Laplace argued, a Demon which could know at a given moment the precise position of all the particles in the universe and all the laws of physics governing their motions, "would embrace in the same formula the movements of the largest bodies in the universe and those of the lightest atom: nothing would be uncertain for it, and the future, like the past would be present to its eyes."[1]

If the Newtonian world view reached the height of its expression in philosophy by the end of the 18th century, it achieved its most extensive application in the social sciences during the century following, when as Floyd Matson points out, "The two fundamental postulates of the scientific mechanist--those of neutral objectivity and analytic reductionism--came to be reflected with varying degrees of accuracy and distortion in many of the most influential social theories of the period"[2]--among them, the "social physics" of Saint-Simon and his disciplie Auguste Comte, the "utilitarianism" of James Mills and Jeremy Bentham, the "natural economics" of Joseph Townsend, and the "social Darwinism" of Thomas Henry Huxley, Herbert Spencer, and William Graham Sumner.[3]

The full significance of the Newtonian conception of the physical

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[1]Pierre Simon de Laplace, Traité de Probabilité, 1886, cited by Floyd Matson, The Broken Image, p. 11.

[2]Matson, The Broken Image, p. 15.

[3]Ibid., pp. 16-24.

universe as clockwork machine, then, lay in its function as the archetype which structured for nearly three hundred years the conduct and the content not only of physics, but of all the sciences. As Matson puts it,

> All phenomena were to be subsumed within the giant mechanism. What could not be stretched or shrunk to fit its procrustean framework was simply not "phenomena" at all, nor even noumena: it was only superstition, a kind of anamorphosis or fallacy of vision which the scientific lens would soon correct, and which meanwhile might better be disregarded. In short, all that mattered was matter. All objects and fields of study--animal, vegetable or mineral--were equally and fully explainable by reduction to the impenetrable atoms which composed them and the physical forces which moved them. . . . The movement which had begun in the laboratories and the learned societies soon spread to all realms of intellectual life and became an urgent concern of civilization itself.[1]

Whether history will show that the "urgent concern of civilization" with the Newtonian world view began to abate in the 20th century, or that it continued through our lifetime and generations beyond, is by no means clear. It is not very difficult to see in what Percy Bridgman calls "the thesis of atomic sufficiency" of the modern behaviorists, for example, the shadow of Laplace's Demon,[2] and it seems unlikely that the Demon or the world view from which it springs will be laid to rest overnight. Nonetheless, there are unmistakeable signs that the foundations of the Newtonian world view have shattered and that, out of the ruins of the clockwork universe, a new and very different view of the world is emerging.

The New Physics

It is entirely appropriate, and perhaps necessary, that the

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[1] Ibid., p. 11.

[2] Percy W. Bridgman, The Way Things Are (Cambridge, Mass.: Harvard University Press, 1959), p. 200.

dissolution of the Newtonian world view began, in the last quarter of the 19th century, in the same place as its creation had begun three centuries before: in the laboratories of physicists. As Werner Heisenberg has pointed out,

> . . . many attempts had been made before to get away from this rigid frame /of Newtonian concepts in the 18th and 19th centuries/ which seemed obviously too narrow for an understanding of the essential parts of reality. But it had not been possible to see what could be wrong with the fundamental concepts like matter, space, time and causality that had been so extremely successful in the history of science. Only experimental research itself, carried out with all the refined equipment that technical science could offer, and its mathematical interpretation, provided the basis for a critical analysis--or, one may say, enforced the critical analysis--of these concepts, and finally resulted in the dissolution of the rigid frame.[1]

While the major assaults on the Newtonian concepts of matter, space, time, and causality did not begin in earnest until the second and third decades of the 20th century, the first intimations of the revolution in modern science came much earlier, in the development of classical thermodynamics and, more significantly, of electromagnetic theory, in the last quarter of the 19th century. In thermodynamics, Clausius, Gibbs, and Boltzmann used Newtonian mechanics to demonstrate that the fundamental laws in the theory of heat could be derived from the assumption that heat is a product of the motion of the smallest parts of matter. To achieve their results, however, the founders of classical thermodynamics were forced to rely on the mathematical theory of probability, and to interpret

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[1]Werner Heisenberg, Physics and Philosophy: The Revolution in Modern Science, World Perspectives Series, Harper Torchbooks (New York: Harper & Row, Publishers, 1962), p. 198.

the fundamental laws in the theory of heat as statistical propositions, rather than certainties.[1] To the extent that it preserved the Newtonian concepts of matter and motion, then, the thermodynamics of Gibbs and Boltzmann was scarcely revolutionary. But in its reliance on probability, thermodynamic theory called into question for the first time the principle of absolute certainty which had become a key feature of the Newtonian world.[2]

The first significant breach in the mechanistic basis of physics came, however, not from thermodynamics, but from the work of Faraday, Maxwell, and Hertz in the development of electromagnetic theory. Electricity and magnetism had, for more than a century before Maxwell, been the subjects of intensive investigation by Newtonian scientists, but through none of their efforts had the two phenomena been made to "fit" into the Newtonian framework. Finally, in 1873, Maxwell arrived at a series of mathematical equations (the electromagnetic theory) which successfully accounted for the operations of magnetism and electricity, but which required the rejection of the very premises of Newtonian physics from which Maxwell had begun.[3] The effects of Maxwell's work on the mechanistic conception of the universe can scarcely be understated, for what Maxwell's equations demonstrated was that, in J. W. N. Sullivan's words,

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[1]Heisenberg, The Physicist's Conception of Nature, pp. 37-38.

[2]Matson, The Broken Image, p. 115.

[3]Ibid.

> All that we knew about electricity was the way it affected our measuring instruments. . . . The precise description of this behavior gave us the mathematical specification of electricity and this, in truth, was all we knew about it. . . . It is only now, in retrospect, that we can see how significant a step this was. . . . It has become evident that, so far as the science of physics is concerned, we do not require to know the entitites we discuss, but only their mathematical structure. And in truth, this is all we do know. It is now realized that this is all the scientific knowledge we have even of the familiar Newtonian entities. Our persuasion that we knew them in some exceptionally intimate manner was an illusion.[1]

The philosophical significance of Maxwell's work--that science does not concern itself with "ultimate reality" but only with our perceptions of it--would not be fully recognized in science for fifty years, but, by the turn of the century, the theoretical implications of his equations were already having their effect. As Matson notes,

> . . . what had come to be accepted /of Maxwell's work/ was already considerable: i.e., that the Newtonian principle of actions at a distance, which lay at the heart of the mechanistic world view, was inadequate to account for the interactions between fields of force demonstrated by the equations of Maxwell, in which the electromagnetic field could exist as a wave independent of the material source. The implications of this breakthrough were soon evident. "What was true for electrical action," as Einstein has recalled, "could not be denied for gravitation. Everywhere Newton's actions-at-a-distance gave way to fields spreading with finite velocity." Everywhere, in short, what had hitherto been regarded as an indispensable cornerstone of the traditional cosmology was quietly and permanently rolled aside.[2]

There was another cornerstone of Newtonian physics which the work of Faraday, Maxwell, and Hertz did not, however, set aside: the concept that space was filled with a "luminiferous ether," an "invisible medium

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[1]J. W. N. Sullivan, The Limitations of Science (New York: Mentor Books, 1949), pp. 140-141.

[2]Matson, The Broken Image, pp. 117-118.

in which the stars wandered and through which light traveled like vibrations in a bowl of jelly."[1] The universal acceptance in physics of the "ether" theory came from logical necessity, for the ether provided the fixed frame of reference, the absolute and immovable space, which Newton's cosmology required. Theories regarding the propagation through space of all the electrical fields postulated by Maxwell, in particular, required the ether, for light had long been established to travel in "undulating waves" and, by the mechanical analogy on which Newton's cosmology was based, it was obvious that waves can only travel through the medium of some material substance. Thus, even Maxwell's electromagnetic fields were held to be propagated by some disturbances of the luminiferous ether.[2]

Despite its necessity for making the Newtonian universe "hang together," however, the ether theory was a source of troublesome problems for the physicists of the 17th, 18th, and 19th centuries--not the least of which was that the existence of the ether had never been demonstrated. In 1881, therefore, two American physicists, A. A. Michaelson and E. W. Morley set out to determine once and for all whether the ether existed. In brief, Michaelson and Morley reasoned as follows: If the earth is indeed traveling through an immovable ether, then its passage should set up an "ether wind" or current flowing in the opposite direction to the earth's forward movement, and the current should travel at a rate equal to the rate of the earth's forward movement through the ether. Moreover, if

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[1]Lincoln Barnett, The Universe and Dr. Einstein, Revised Edition with Foreword by Albert Einstein (New York: Bantam Books, 1968), p. 41.

[2]Ibid.

light is indeed propagated through the ether, then the speed of a beam of light sent in the direction of the earth's forward movement (i.e., against the "ether current") should be retarded by just the speed of the ether current, while the speed of a beam of light sent in the opposite direction (i.e., with the ether current) should be increased by the speed of the current. To test their hypothesis, Michaelson and Morley constructed of mirrors a highly sensitive instrument (the "interferometer") which would allow a single beam of light to be directed simultaneously in two different directions, and any difference in its speed against the ether current and with the ether current measured. What they found, and what repetitions of their work in the following years confirmed, was that the velocity of light was not affected in the least by its direction in relation to the earth's movement.[1]

As Lincoln Barnett points out in his summary of the Michaelson-Morely experiment, its consequences for science were painful:

> The Michaelson-Morley experiment confronted scientists with an embarrassing alternative. On the one hand they could scrap the ether theory which had explained so many things about electricity, magnetism, and light. Or if they insisted on retaining the ether they had to abandon the still more venerable Copernican theory that the earth is in motion. To many physicists it seemed almost easier to believe that the earth stood still than that waves--light waves, electromagnetic waves--could exist without a medium to sustain them. It was a serious dilemma and one that split scientific thought for a quarter century. Many new hypotheses were advanced and rejected. The experiment was tried again by Morley and by others, with the same conclusion: the apparent velocity of the earth through the ether was zero.[2]

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[1] Ibid., pp. 41-44. Cf. Heisenberg, Physics and Philosophy, pp. 111-112.

[2] Barnett, The Universe and Dr. Einstein, p. 44.

By the turn of the century, then, the Newtonian world view had already been badly shaken. Thermodynamics, with its reliance on probability, had disturbed the confidence of science in the ideal of certainty. Electromagnetic theory had demonstrated that fields of force could exist as waves independent of the material source, and that science could not explain the "essences" of things, but only their effects on our instruments--the extensions of human perception. And Michaelson and Morley had demonstrated that the "absolute and immovable space" of Newtonian mechanics--the ether--apparently did not exist. For all their significance, however, these 19th-century discoveries left the conceptual building blocks of the Newtonian universe--time, space, motion, and atomicity--intact. As Matson puts it,

> Even though in the explanation of electricity "matter" had been replaced by "fields of force," the interactions between fields could still be viewed as taking place in Newtonian space and time, in accordance with accepted laws. Moreover, they could still be described with the requisite objectivity (i.e., without regard for the manner of their observation); and, finally, they were still dependent upon the ancient foundation of atoms, which remained as ever the indivisible building stones of the material universe.[1]

The problem, as physicists in the closing years of the 19th century saw it, was to reinterpret the findings of Maxwell and Hertz, Michaelson and Morley, so as to bring them into line with the "givens" of Newtonian physics. This was essentially the aim of Lorentz, for example, who worked from 1894 to 1904 to find an interpretation of Michaelson and Morley's findings which would reconcile the wave equations for the propagation of light with the Newtonian "principle of relativity" which held that, in Heisenberg's words,

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[1]Matson, The Broken Image, p. 119.

> If in a certain system of reference the mechanical motion of bodies fulfills the laws of Newtonian mechanics, then this is also true for any other frame of reference which is in uniform non-rotating motion with respect to the first system. Or, in other words, a uniform translational motion of a system does not produce any mechanical effects at all and can therefore not be observed by such effects.[1]

In 1904, Lorentz succeeded in bringing Maxwell's, Michaelson's, and Morley's findings into conjunction with the Newtonian concepts of absolute space and time through a series of mathematical transformations which relied on the novel hypothesis that, "in different systems of reference there are different 'apparent' times which in many ways take the place of the 'real' time."[2] Through his transformations, and the postulate of a "local time" distinct from "universal time," Lorentz was able to demonstrate that the "apparent" velocity of light was the same in every system of reference. Such was the overwhelming power of the Newtonian world view, however, that though Lorentz's work took him to the brink of a new construction of the universe, he could not see the necessary next step--the abandonment of Newtonian "universal" time altogether. Einstein, of course, did, and if his perception of that step is a measure of his genius, then his taking it is a measure of his courage, for the ultimate consequence of the Special and General Theories of Relativity was to obliterate the hard and fast distinctions--between time and space, mass and energy, matter and motion, and "subjective" and "objective" reality--on which the Newtonian world view was founded.

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[1]Heisenberg, Physics and Philosophy, p. 113.

[2]Ibid., pp. 113-114.

Matson sums up in dramatic terms the consequences of Relativity for the practice, and the philosophy, of science:

> With the appearance of relativity, the study of the inner workings of nature passed from the engineer-scientist to the mathematician. In the new theories, gravitation was no longer regarded as a mechanical "force," but instead took on the character of a mathematical formula governing the curvature of space and the acceleration of moving bodies. Space and time, those formidable absolutes of the common-sense world, lost their absoluteness and their independence, as they were welded into a single four-dimensional continuum of space-time. . . . If the mechanistic universe was not yet overthrown, it was surely altered (not to say disfigured) beyond easy recognition. Not "matter" but "energy" was now the basic datum of science; no reliance could henceforth be placed upon actions-at-a-distance, nor upon mechancial conceptions of force or of quasi-solid ethers, nor upon the integrity and stability of Space and Time as familiarly conceived, nor, indeed, upon the bedrock axioms of Euclidean geometry.[1]

Alfred North Whitehead is even more emphatic. "The progress of science," he wrote in 1925,

> has now reached a turning point. The stable foundations of physics have broken up. . . . The old foundations of scientific thought are becoming unintelligible. Time, space, matter, material, ether, electricity, mechanism, organism, configuration, structure, pattern, function, all require reinterpretation. What is the sense of talking about a mechanical explanation when you do not know what you mean by mechanics?[2]

There was one principle of the Newtonian world view that even Einstein's work, however, left untouched: the principle that Nature is regular, uniform, and continuous in all its effects, and is, therefore, in principle at least, deterministic and entirely predictable--a closed system. Even while Einstein was working toward the Theory of Relativity, however, physicists were studying a different problem whose solution would

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[1]Matson, The Broken Image, pp. 119-120.

[2]Alfred North Whitehead, Science and the Modern World (New York: Mentor Books, 1948 /orig. ed. 1925/), pp. 17-18.

lead, ultimately, to quantum physics and to what many call the "real revolution" in modern science--the rejection of physical causality and mechanical determinism. The problem they were concerned with, sometimes called the "black body problem," derived from the commonly observed phenomenon that any piece of matter, when heated, glows first red, then yellow, then white as the temperature increases. For a black body, the radiation given off at any point in the heating process depends solely on the temperature, and should be predictable, therefore, from the application of known laws (from Newtonian principles) for radiation and heat. Late 19th-century attempts to explain the change in radiation of black bodies at different temperatures through Newtonian principles repeatedly failed, but in 1900, Max Planck arrived at a mathematical formula which "fit" all the observed relations between wave lengths of radiation and heat. The physical interpretation of his formula, however, required a drastic departure from the Newtonian assumption that energy is emitted and absorbed in a continuous stream, and in December, 1900, Planck published the only theoretical explanation that could account for the operation of his law of heat radiation: the Quantum Theory, which stated that radiant energy is not emitted in a continuous stream, but in finite, discontinuous "packets," or quanta.[1]

Despite the fact that the Quantum Theory shook to its very foundations the principle faith of science in the continuity of nature, the full extent of the revolution which quantum theory represented was not realized

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[1]Heisenberg, Physics and Philosophy, pp. 30-32. Cf. Barnett, The Universe and Dr. Einstein, p. 23.

until 1905, when Einstein extended its application to all forms of radiant energy, including light. Working from the assumption that light, like heat, is composed of discrete packets of energy (which he called "photons"), Einstein was able to explain for the first time the phenomenon known as the photoelectric effect,[1] and for the Photoelectric Law to which his calculations led, he was awarded the Nobel Prize.

It was in the application of quantum theory to light that its revolutionary consequences began to become fully apparent, for, while the Photoelectric Law solved a number of the problems of physics, it raised even more serious new ones. Two centuries of experimentation and theory dealing with the various phenomena of light--for example, diffraction and interference--had established beyond doubt that light must travel in waves. Yet Einstein had also demonstrated beyond doubt that light must consist of particles. For the first time in the history of science, in short, the fundamental principle that nature is regular and uniform was called into serious question.

The successive applications of quantum theory in the next two decades--particularly, in the theory of atomic structure proposed by Niels Bohr--far from resolving the apparent paradox of particle and wave, seemed to confirm in every set of experiments the existence of a fundamental duality in the nature of matter. In 1925, therefore, Louis de Broglie accepted the duality of matter as a fundamental law of physics and attempted to apply it in explaining the behavior of nature's most elusive particles, the electrons, which had theretofore been generally

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[1] Barnett, The Universe and Dr. Einstein, pp. 24-26.

conceptualized as hard elastic spheres. The difficulties generated by this conception, de Broglie argued, could be resolved by regarding electrons not as definite particles, but as systems of waves which, in their totality, took on the characteristics of "matter."[1]

Within a year of de Broglie's publication of his conception of "matter waves," the Viennese physicist Schrödinger, starting from a similar conception, formulated a coherent mathematical system that accounted for quantum phenomena by attributing specific wave functions to protons and electrons, and, by 1927, the "wave mechanics" of de Broglie and Schrödinger had been confirmed experimentally by the American physicists Germer and Davisson.[2] Germer and Davisson's work, moreover, was not confined to the behavior of electrons. Whole atoms and even molecules, they found, exhibit wave characteristics which coincide precisely with predictions made on the basis of de Broglie's and Schrödinger's theory of "matter waves."[3]

The development of wave mechanics, however, simply stressed more than ever the paradox presented by waves of matter on the one hand and particles of light on the other. From the autumn of 1926 until the autumn of 1927, therefore, that paradox and how it might be resolved was almost the sole subject of intensive discussions among such physicists as Niels Bohr, Schrödinger, Heisenberg, Max Born, and Einstein--the so-called

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[1] Ibid., p. 28.

[2] Ibid., p. 29.

[3] Ibid.

"Copenhagen group"--and, in the course of that year, a solution to the problem was formulated which has since come to be called "the Copenhagen interpretation of Quantum Theory."[1]

The Copenhagen interpretation of Quantum Theory relies on two principles or laws of physics which, as Heisenberg notes, changed for all time "the fundamental concepts concerning reality" on which pre-quantum science was based.[2] The first is Heisenberg's "relations of uncertainty" or "principle of indeterminacy," and the second is Niels Bohr's "principle of complementarity." The thesis of Heisenberg's principle is, in brief, that there is a fundamental indeterminacy in the atomic universe, and in our knowledge of it, that is not due merely to imprecision in our instruments or technical limitations on our powers of observation, but stems from the very nature of things and constitutes an ultimate, unbreachable barrier to our ever knowing how things "really" are. To demonstrate that indeterminacy is not a technological but an ontological condition, Heisenberg constructed a hypothetical "ideal" experiment in which a physicist, given an imaginary supermicroscope powerful enough to bring an electron into the range of vision, attempts to define the position and velocity of a single electron. To make the electron visible, Heisenberg pointed out, the physicist must direct some form of light upon it and, since the electron is so tiny, the light waves must be very short if they are to illuminate it. But, as Einstein demonstrated in his experiments

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[1] Heisenberg, Physics and Philosophy, pp. 42-43.

[2] Ibid., p. 43.

on the photoelectric effect, the higher the frequency of the light waves falling on electrons (i.e., the shorter their wave lengths) the greater the force with which the electrons are displaced from their initial positions. Hence, Heisenberg concluded, by the very act of observing the electron's position, the imaginary physicist must alter its velocity (in physics, a measure of both speed and direction), and, conversely, by the act of measuring its velocity must alter its position. The position and velocity of an individual electron, therefore, can never be determined with equal precision, but can only be expressed as a probability function.[1]

Using Heisenberg's Principle of Indeterminacy--the "relations of uncertainty"--as a base, Heisenberg and Max Born developed a new mathematical system for describing quantum phenomena which "fit" both the particle and wave conceptions of the atomic and sub-atomic universe. As Lincoln Barnett explains,

> The idea behind their system had a profound influence on the philosophy of science. They maintained it is pointless for a physicist to worry about the properties of a single electron; in the laboratory he works with beams or showers of electrons, each containing billions of individual particles (or waves); he is concerned therefore only with mass behavior, with statistics and the laws of probability and chance. So it makes no practical difference whether individual electrons are particles or systems of waves--in aggregate they can be pictured either way. For example, if two physicists are at the seashore one may analyze an ocean wave by saying, "Its properties and intensity are clearly indicated by the positions of its crest and trough"; while the other may observe with equal accuracy, "The section which you term a crest is signifi-

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[1]Heisenberg provides a readable account of the reasoning which underlies his "relations of uncertainty" and the essential meaning of the Principle of Indeterminacy in Physics and Philosophy, 47-48, and Barnett provides a similar account in The Universe and Dr. Einstein, pp. 32-34.

> cant simply because it contains more molecules of water than the area you call a trough." Analogously, Born took the mathematical expression used by Schrödinger in his equations to denote wave function and interpreted it as a "probability" in a statistical sense. That is to say, he regarded the intensity of any part of a wave as a measure of the probable distribution of diffraction, which hitherto only the wave theory could explain, in terms of the probability of certain corpuscles--light quanta or electrons--following certain paths and arriving at certain places. And so "waves of matter" were reduced to "waves of probability." It no longer matters how we visualize an electron or an atom or a probability wave. The equations of Heisenberg and Born fit any picture.[1]

At roughly the same time as Heisenberg and Born were working out the new probability mathematics of quantum theory, Niels Bohr was introducing the concept of "complementarity" to interpret the wave/particle paradox. The particle theory, Bohr noted, offered an enormously useful and experimentally validated explanation for a wide variety of phenomena, but failed to account for an almost equally wide range of phenomena in somewhat different experimental situations. The wave theory, on the other hand, accounted for the phenomena which the particle theory could not explain, but could not accommodate the phenomena which the particle theory accounted for. The two theories, Bohr argued, were not, therefore, contradictory, but complementary--meaning that the two pictures of atomic behavior are mutually exclusive in any given situation, but are both necessary for a full explanation of all the phenomena observed. To ask which of the two conceptions is "really" the way atoms are is like asking which side of a coin is "really" the coin. Neither is, but both are.[2]

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[1]Barnett, The Universe and Dr. Einstein, pp. 30-31.

[2]Matson, The Broken Image, p. 132.

The significance in physics of Bohr's principle of complementarity was that it offered a theoretical resolution not only to the apparent paradox of particle and wave, but to the problems of defining electron position and velocity to which Heisenberg had pointed (Bohr argued that position and velocity are also complementary functions), and to a variety of other quantum paradoxes, as well. Needless to say, the principle of complementarity was not accepted in physics on the grounds of its logical soundness alone; its success derived primarily from the fact that experimental findings confirmed the duality-without-contradiction that Bohr's principle predicted and, more important, the principle "fit" concisely the new mathematical interpretation of quantum theory to which Heisenberg's "relations of uncertainty" had led. Heisenberg sums up the relationship between Bohr's Principle of Complementarity and his own Principle of Indeterminacy as follows:

> Bohr considered the two pictures--particle picture and wave picture--as two complementary descriptions of the same reality. Any of these descriptions can be only partially true, there must be limitations to the use of the particle concept as well as of the wave concept, else one could not avoid contradictions. If one takes into account those limitations which can be expressed by the uncertainty relations, the contradictions disappear.[1]

The significance of the Principle of Indeterminacy and the Principle of Complementarity extends, however, far beyond the world of microphysics. As physicists themselves were relatively quick to point out, indeterminancy means, for one thing, that "reality" can no longer be construed as mechanistic, deterministic, and causal. As Oppenheimer writes,

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[1]Heisenberg, Physics and Philosophy, p. 43.

the world revealed by the Copenhagen interpretation of quantum theory

> . . . is not causal; there is no complete causal determination of the future on the basis of available knowledge of the present. It means that every intervention to make a measurement, to study what is going on in the atomic world, creates, despite all the universal order of this world, a new, a unique, not fully predictable situation.[1]

Moreover, the relations of uncertainty which hold within the atom's shell do not stop there, for, as J. Bronowski points out,

> . . . once we have any uncertainty in prediction, in however small and distant a corner of the world, then the future is essentially uncertain--although it may remain overwhelmingly probable.[2]

But indeterminacy and complementarity did not attack the mechanistic causality of the Newtonian world view alone; it went farther, and attacked the most fundamental concept on which the Newtonian perspective was based: the concept that science studies an objective reality which exists "out there," independent of the scientist. What the uncertainty principle demonstrated, in Heisenberg's own words, was that

> When we speak of the picture of nature in the exact science of our age, we do not mean a picture of nature so much as a picture of our relationships with nature. The old division of the world into objective processes in space and time and the mind in which these are mirrored--in other words, the Cartesian difference between res cogitans and res extensa--is no longer a suitable starting point for our understanding of modern science. Science, we find, is now focused on the network of relationships between man and nature, on the framework which makes us as living beings dependent parts of nature, and which we as human beings have simultaneously made the object of our thoughts and actions. Science no longer confronts

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[1]J. Robert Oppenheimer, Science and the Common Understanding (New York: Simon and Schuster, 1954), p. 62.

[2]Bronowski, The Common Sense of Science, p. 69.

> nature as an objective observer, but sees itself as an actor in this interplay between man and nature. The scientific method of analyzing, explaining and classifying has become conscious of its limitations, which arise out of the fact that by its intervention science alters and refashions the object of investigation. In other words, method and object can no longer be separated. The scientific world-view has ceased to be a scientific view in the true sense of the word.[1]

In the light of the last sentence in the preceding quotation (which Heisenberg himself underscored), it is difficult to imagine that any other principle in physics could have effects more revolutionary than Heisenberg's. Yet many physicists and philosophers of science attribute to Bohr's concept of complementarity even greater significance for the course of science and human understanding. Perhaps because, of Indeterminancy and Complementarity, the latter is the more generalized principle, it has found wider application in fields of inquiry outside physics--most significantly, in biology and psychology.

Max Born was among the first physicists to foresee the potential significance of complementarity in sciences outside of physics. "The fact that in an exact science like physics," he wrote, "there are mutually exclusive and complementary situations which cannot be described by the same concepts, but need two kinds of expression, must have an influence, and I think a welcome influence, on other fields of human activity and thought."[2] And Louis de Broglie suggested the relation between physics and biology when he wrote, in his own discussion of the principle of

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[1]Heisenberg, The Physicist's Conception of Nature, pp. 28-29.

[2]Max Born, Physics in My Generation (London and New York: Pergamon Press, 1956), cited by Matson, The Broken Image, p. 134.

complementarity, that the quantum system "is a kind of organism, within whose unity the elementary constituent units are almost reabsorbed."[1] As de Broglie pointed out, complementarity meant, among other things, that the behavior of particles cannot be understood apart from the system in which they function, and the system cannot be understood if the particles which comprise it are wrenched out of their relations with one another.[2]

Insights such as Born's and de Broglie's, with their emphasis on such traditionally biological concepts as "organism" and "holism," along with Bohr's own perception that the complement in science of "mechanisms and causes" must be "purposes and reasons," inevitably led a number of quantum physicists--among them, deBroglie, Schrödinger, Born, Bohr, and Pascual Jordan--to turn their attention to investigations of the life sciences. In biology, in particular, the new perspectives on man, science, and "reality" that the quantum physicists brought with them were to have a profound effect.

More than any other of the natural sciences, biology has a history of dualism. From its beginnings to the present, the field has been a battleground on which the representatives of "vitalism" and "mechanism" have fought for supremacy--or at least for equal status. During the 300 or more years while the Newtonian perspective defined "science," however, biology moved steadily toward the mechanistic conception of life, until, by the end of the 19th century, the conclusion that all physiology and all

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[1]Louis de Broglie, Matter and Light: The New Physics (New York: Horton, 1939), cited by Matson, The Broken Image, p. 133.

[2]Matson, The Broken Image, p. p. 113.

organic activity (including the activities of "mind") must ultimately be reducible to the laws of mechanics seemed inescapable. And, as Matson puts it, "So long as biologists waited for their cues at the door of the physics laboratory--and while the only sound to be heard from within was the clank of mechanical models--this assumption was indeed 'self-evident.'"[1]

By the third decade of the 20th century, however, the physicists were emerging from their laboratories with a quite different message for the biologists, and what they had to say of indeterminacy and complementarity gave support to a new conception of the nature of living organisms being advanced just then by a handful of biologists--primary among them the German biologist Ludwig von Bertalanffy. That conception consisted of a series of principles of organic behavior, and a theory which would account for those principles, which may be summarized as follows:

1. Living organisms have a characteristic wholeness that cannot be explained by analysis of their component parts in isolation.

2. Organization is an inherent characteristic of every organism.

3. The organization of organisms is maintained by dynamic, rather than mechanical, processes.

4. Organisms are primarily active and goal-seeking, rather than passive and reactive.

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[1] Ibid., p. 142.

5. Organisms exhibit wholeness, organization, dynamism, and teleology because, unlike the systems studied by chemists and pre-quantum physicists, they are open systems, exchanging matter and energy with their environments.[1]

Certain of these principles had, of course, been advanced before in biology--particularly, the concepts of wholeness and teleology--but such concepts had been dismissed by the mechanists as "chimera of fools and ignoramuses,"[2] in La Mettrie's words, because they could not fit the Newtonian frame. By 1940, however, the quantum physicists had provided a new framework which not only permitted but supported such conceptions as von Bertalanffy and others advanced. "The time of materialism is over," advised Max Born, for example. "We are convinced that the physico-chemical aspect is not in the least sufficient to represent the facts of life, to say nothing of the facts of mind."[3] "Owing to the essential feature of complementarity," wrote Niels Bohr, "the concept of purpose which is foreign to mechanical analysis finds a certain application in biology."[4] The application of Heisenberg's indeterminacy relations in the study of living systems, suggested the physicist William G. Pollard, indicates that there is an impassable limit beyond which the mechanico-mathematical analysis of organic activity cannot proceed without so dis-

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[1]Ibid., pp. 143-148.

[2]De La Mettrie, L'Homme Machine, 1748, cited by Heisenberg, The Physicists's Conception of Nature, p. 137.

[3]Born, Physics in My Generation, cited by Matson, The Broken Image, p. 142.

[4]Niels Bohr, Atomic Physics and Human Knowledge (New York: John Wiley & Sons, 1958), cited by Matson, The Broken Image, p. 141.

turbing the organism that it becomes unrecognizable. Therefore, Pollard concluded, mechanico-mathematical analysis must be "complemented in the study of life by alternative methods of understanding which take into account the unique, irreducible, and unquantifiable characteristics of the live subject matter."[1] On the basis of his own analysis of specific biological and physiological phenomena, the quantum physicist Pascual Jordan reached a similar conclusion. The application of quantum principles to the study of living systems, he wrote, leads to the conclusion "that the organism is quite different from a machine and that its living reactions possess an element of fundamental incalculability and unpredictability."[2]

Harold G. Wolff has summed up the impact of the new physics on biology as follows:

> The revolt in physics against the Cartesian concept of a mechanical universe raised doubts about the ideal model for science imposed by physics. Far from being disrupting, this change made it easier for many biologists to admit into the study of the form and function of parts of living systems their purpose in relation to the goals of the living organisms and to accept the thesis that biological concepts can emerge from a study of integrated systems in which new and different relations between creature and setting engender new and different behavior patterns.[3]

Out of the complex chain of events and discoveries in physics and biology during the first half of the 20th century, then, a view of the universe has emerged which is strikingly different from the Newtonian view.

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[1]William G. Pollard, "The Significance of Complementarity for the Life Sciences," American Journal of Physics, XX (1952), cited by Matson, The Broken Image, p. 144.

[2]Pascual Jordon, Physics of the Twentieth Century (New York: Philosophical Library, 1944), cited by Matson, The Broken Image, p. 145.

[3]Harold G. Wolff, "The Mind-Body Relationship," in Lyman Bryson, ed., An Outline of Man's Knowledge of the Modern World (Garden City, N.Y.: Nelson Doubleday, 1960), cited by Matson, The Broken Image, p. 146.

Where the Newtonian scientist saw mechanism and causality, the new scientist sees organism and teleology. Where the Newtonian scientist saw certainty and determinism, the new scientist sees possibility and indeterminacy. Where the Newtonian scientist saw singularity and universality, the new scientist sees duality and complementarity. Where the Newtonian scientist saw "objective reality," the new scientist sees his own reflection. Where the Newtonian scientist saw, finally, a universe of particles in one-way, linear, causal relations, the new scientist sees a universe of patterns, wholes, systems in complex, multi-dimensional, dynamic interactions.

Viewed from the perspective of 20th-century science, from the emerging world view which has come to be known as the "systems perspective," the universe "does not come as clean," in Whitehead's phrase, as the Newtonian view gives it to us. Yet, as Laszlo argues, "some knowledge of connected complexity is preferable even to a more detailed knowledge of atomized simplicity, if it is connected complexity with which we are surrounded in nature and of which we are ourselves a part."[1]

To date, our knowledge of the connected complexity of things is not very far advanced. But the systems perspective provides us, at least, with some basic guidelines for organizing the questions we ask about complex phenomena--and that is, as most scientists and philosophers would agree, the first step in the development of any new science. What the principles of the systems perspective are, and what they imply for the

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[1]Laszlo, The Systems View of the World, p. 13.

organization of questions and information about complex phenomena, is discussed in some detail in the following chapter.

CHAPTER 4

THE SYSTEMS PERSPECTIVE: PRINCIPLES AND GUIDELINES FOR MODELS

As Ervin Laszlo points out in his Introduction to The Relevance of General Systems Theory, what is sometimes referred to as the "systems movement" today is a vast complex of ideas and ideals at very different levels of abstraction,[1] and it is a difficult task in itself to sort out the different meanings of such terms as "a systems perspective," "a systems approach," "systems science," "systems research," "systems theory," and "general systems theory." A review of the literature suggests, however, that systems studies fall into two large fields: general systems theory and specific systems theory and research. General systems theory takes as its goal the unification of the sciences and social sciences through the creation of a metadiscipline (general systems) whose purpose is to formulate a metatheory of systems.[2] Specific systems theory and research, on the other hand, takes as its goal the formulation of specific theories and laws regarding the components, organizational structure, and behavior-as-a-whole of systems in particular disciplines--

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[1]Ervin Laszlo, ed., The Relevance of General Systems Theory (New York: George Braziller, Inc., 1972), p. 4.

[2]Ludwig von Bertalanffy, General System Theory: Foundations, Development, Applications (New York: George Braziller, Inc., 1968), p. 38.

e.g., biology, sociology, economics, education, psychology, and so on.[1] The two fields are, of course, related in a number of ways. While the methodology of general systems theory is primarily hypothetico-deductive,[2] for example, it also builds on the empirico-inductive findings of the specialized research,[3] and, conversely, some of the research in the specialized fields derives from the hypothetico-deductive formulations of the general systems theorists.[4] More important, the two fields share a common ground: a conceptual picture of the world which, on the one hand, underlies the hope for an integrated theory for all science, and, on the other, directs the formulation of specific research questions and models. That conceptual picture--composed for the most part of shared definitions, general principles derived from those definitions, and the methodological implications of those definitions and principles--constitutes the systems perspective, or the systems approach to nature and to science.

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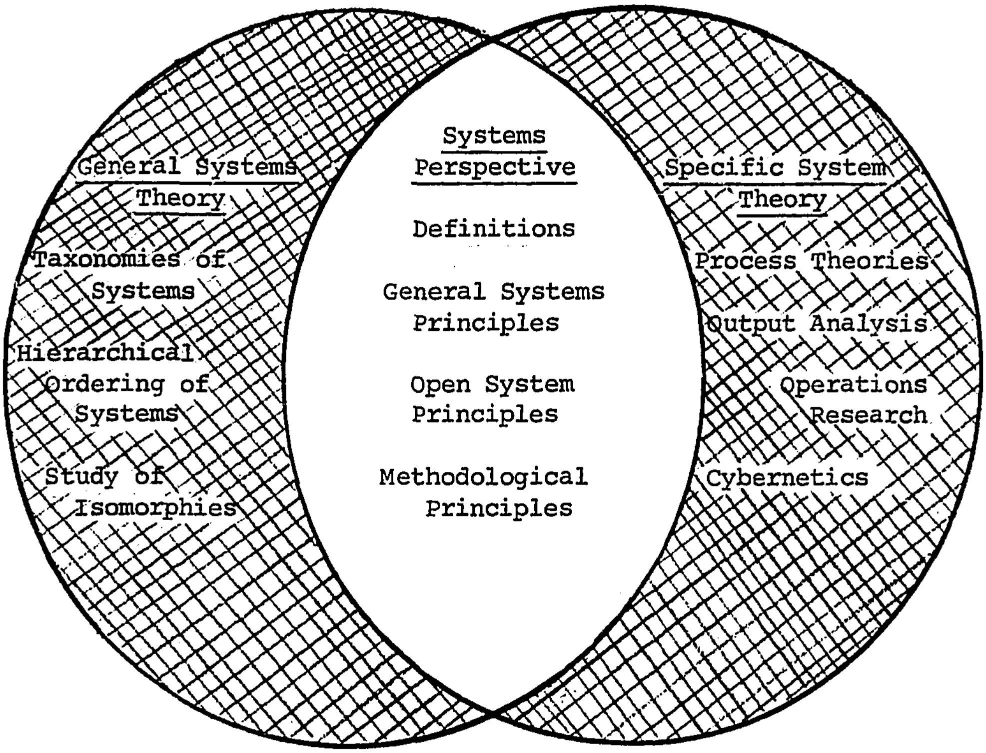
[1]See, for example, in biology, Ludwig von Bertalanffy, Problems of Life (New York: John Wiley & Sons, 1952); in sociology, N. H. Demerath and R. A. Peterson, eds., System, Change and Conflict (New York: Free Press, 1967); in economics, Kenneth E. Boulding, The Organizational Revolution (New York: Harper Brothers, 1953); in education, Glenn L. Immegart, "Systems Theory and Taxonomic Inquiry into Organizational Behavior in Education," in Daniel E. Griffiths, ed., Developing Taxonomies of Organizational Behavior in Education Administration, Rand McNally Educational Administration Series (Chicago: Rand McNally & Company, 1969); in psychology, Robert M. Gagne, et al., Psychological Principles in System Development (New York: Holt, Rinehart & Winston, Inc., 1966); see also the contributions from various disciplines in General Systems, the Yearbook of the Society for General Systems Research, I-XX (1954-1973).

[2]Ervin Laszlo, The Systems View of the World (New York: George Braziller, Inc., 1972), p. 26.

[3]Von Bertalanffy, General System Theory, p. 95.

[4]Laszlo, The Relevance of General Systems Theory, p. 9.

The concerns of general systems theory, specific systems theory and research, the systems perspective, and their relationships are represented diagrammatically in Figure 1.



The Systems Perspective

Figure 1

The principles of the systems movement which concern us in this investigation are those represented in the field where general systems theory and specific systems theory and research overlap: the principles of the systems perspective. The material in the shaded portions of Figure 1 has been excluded from consideration here because, on the one hand, a general theory of systems does not yet exist (except as a goal), and, on the other, specialized systems theories and research results are not yet generalizable enough to serve as a basis for evaluating models in other disciplines.[1]

As noted earlier, the systems perspective is composed, for the most part, of a series of definitions, of principles derived from those definitions (and supported, in some instances, by empirical observation), and of methodological implications derived from those definitions and principles. The following outline attempts to state and explicate, in brief, the principles of the systems perspective on which most writers agree.[2] For the sake of convenience, the principles are organized in four general categories: 1) basic presuppositions, 2) definitions of system and general system properties, 3) definitions of open system and open system properties, and 4) methodological principles.

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[1]Anatol Rapoport, "The Search for Simplicity," The Relevance of General Systems Theory, p. 28.

[2]Each of the principles identified in the outline appears in O. R. Young's comprehensive index to systems principles found in the work of more than fifty writers on systems theory and applications, in "A Survey of General Systems Theory," General Systems, IX (1964), pp. 61-82; most of the principles identified here also appear in A. D. Hall and R. E. Fagen, "Definition of System," General Systems, I (1956), pp. 18-28; in Gordon Hearn, Theory Building in Social Work (Toronto: University of Toronto Press, 1958), pp. 43-51; in Daniel E. Griffiths, "The Nature and Meaning of Theory," Behavioral Science and Educational Administration, S.S.E. Yearbook, Part II, 1964 (Chicago: University of Chicago Press, 1964), pp. 116-117; in Roy R. Grinker, ed., Toward a Unified Theory of Human Behavior (New York: Basic Books, 1956); in Glenn L. Immegart, "Systems Theory and Taxonomic Inquiry," pp. 167-174; in Laszlo, The Relevance of General Systems Theory and The Systems View of the World; and in von Bertalanffy, General System Theory and Robots, Men and Minds: Psychology in the Modern World (New York: George Braziller, Inc., 1967). Rather than providing a comprehensive listing of all the sources in which each principle appears, the investigator has, in the interest of brevity, provided for each principle in the outline a single reference to a representative source--usually, to the source in which the principle is stated in its most concise form.

The Systems Perspective: Principles

1.0 Basic Presuppositions

1.1 The "atomistic" approach to the description and explanation of natural phenomena (i.e., the view that all phenomena can be explained by reducing them to ultimate "building blocks" in one-way, linear, causal relations) is inadequate for the description and explanation of complex phenomena.[1] Physical reductionism can tell us, in Laszlo's words, "how one cell or organ reacts to one particular kind of stimulant, or how one body reacts to one particular kind of force." But it cannot tell us "how a number of different things act together when exposed to a number of different influences at the same time."[2]

The example most commonly cited in support of this presupposition is drawn from atomic physics:

> A hydrogen atom is composed of a proton and neutron in its nucleus and one electron in its shell, but the number of forces acting within it are so complex that mathematicians need multidimensional spaces to represent them. And atoms more complex than helium (which has two orbital electrons) contain three or more "bodies" in their shells, and our mathematics are incapable of solving the three-body problem--that is, handling equations of motion for more than two objects moving under mutual influence. In other words, we are quite incapable of proceeding with the rigorous techniques of specialization for any phenomenon more complex than a helium atom.[3]

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[1]Laszlo, The Systems View of the World, pp. 5-6.

[2]Ibid., p. 5.

[3]Ibid.

Von Bertalanffy cites the same example, but emphasizes that the "three-body problem" is not simply insoluable in practice, but in principle as well.[1]

1.2 Complex phenomena are wholes with properties that cannot be reduced to the sum of the properties of their parts.[2] To take some simple examples: The properties of a house as a whole (e.g., its height, size, shape, internal area, etc.) cannot be calculated from the properties of the bricks--separately or in sum--which make it up.[3] The performance of a baseball or basketball team as a whole in a given game cannot be calculated from the performances of the individual players.[4] The characterisitcs of the human personality as a whole cannot be calculated as the simple sum of one's feelings, volitions, instincts, and conceptions.[5]

1.3 Complex phenomena exhibit holistic characteristics by virtue of the organizational relations between their component parts.[6] In the examples cited above, for instance, the properties of the house derive from the relationships among the bricks (i.e., their arrangement in relation to one another in space), the

[1]Von Bertalanffy, General System Theory, p. 93.

[2]Lazlo, The Systems View of the World, pp. 7-8.

[3]Ibid., p. 20.

[4]Ibid., p. 7.

[5]Ibid., p. 32.

[6]Ibid., pp. 9-10.

performance of the team derives from the relationships among the performances of the individual players (e.g., passing in basketball, must be related to shooting in a particular pattern), and the characteristics of personality as a whole are derived from the mutual interaction of feelings, volitions, instincts, conceptions, and so on.

1.4 To understand the behavior of complex phenomena, therefore, we must approach them as systems--broadly defined as complex entities, composed of interdependent parts, which have properties as a whole that are not reducible to the sum of the properties of the parts, but are the product of the parts and their organizing relations.[1]

2.0 Definitions of System and General System Properties

2.1 "A system can be defined as a complex of interacting elements. Interaction means that elements, p, stand in relations, R, so that the behavior of an element p in R is different from its behavior in another relation, R'."[2] This means that a) the structure of the system as a whole determines the behavior of any part of the system, and b) the behavior of the system as a whole is determined by the specific relations among its parts.[3]

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[1] Ibid., pp. 12-13.

[2] Von Bertalanffy, General System Theory, pp. 55-56.

[3] Hall and Fagen, "Definition of System," p. 21.

Von Bertalanffy provides the following example of a system: "Three electrical conductors have a certain charge which can be measured in each conductor separately. But if they are connected by wires, the charge in each conductor depends on the total constellation, and is different from its charge when insulated."[1]

2.2 All systems have environments.[2] "For a given system, the environment is the set of all objects a change in whose attributes affect the system and also those objects whose attributes are changed by the behavior of the system."[3]

For a physiological system such as the brain, for example, the environment would include such "objects" as the blood vessels supplying it, the heart, the lungs, the spinal cord, and so on. For a social system such as a basketball team, the environment would include such "objects" as the opposing team, the physical characteristics of the basketball court, and the rules of the game. For a linguistic system such as a word, the environment would include such objects as the words around it, the paralinguistic features accompanying it, the non-verbal behaviors associated with it, and so on.

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[1]Von Bertalanffy, General System Theory, p. 67.

[2]Immegart, "Systems Theory and Taxonomic Inquiry," p. 167.

[3]Hall and Fagen, "Definition of System," p. 20.

2.3 All systems have boundaries, ". . . which are more or less arbitrary demarcations of that included within and that excluded from the system."[1] A boundary is, in other words, the dividing line--imposed by the observer--between a system and its environment.[2]

While all boundaries are more or less arbitrarily imposed, some seem more "natural" to us than others. It is conventional in thinking of the human organism as a physiological system, for example, to draw the system boundary at the skin, and to regard anything "outside" the skin (including the air drawn into the system) as "environment." It is conventional in thinking of the individual as a psychological system to draw the boundary where self-awareness (the direct perception of one's internal state) ends.[3] As Hall and Fagen, among others, point out, however, the line distinguishing between system and environment "ultimately depends on the intentions of the one who is studying the particular universe as to which of the possible configurations of objects is to be taken as the system."[4]

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[1]Immegart, "Systems Theory and Taxonomic Inquiry," p. 167.

[2]Hall and Fagen, "Definition of System," p. 20.

[3]Grinker, Toward a Unified Theory of Human Behavior, pp. 340-342.

[4]Hall and Fagen, "Definition of System," p. 20.

2.4 Systems are organized in interacting hierarchies, or as "fields within fields within fields," so that a system as a whole at one "level" may be at the same time a component of a system at a "higher level," and, conversely, a component of a system may be at the same time an entire system at a "lower level."[1]

To take an example from physiology, the brain is a complex system in itself, composed of interdependent parts (e.g., the left and right hemispheres) and having characteristics as a whole (e.g., a particular pattern of electrical charges) that are not reducible to the characteristics of its component parts (the electrical charges of each of the two hemispheres in isolation); at the same time, the brain serves a specialized function as a component in a larger system (the central nervous system), which is in itself a component of a still larger system (the physiological system as a whole), and so on. Also at the same time, each of the components of the brain as system (e.g., the right and left hemispheres) is a complex system in itself, composed of interdependent parts (e.g., the different lobes of the hemisphere), each of which is, in turn, a complex system of a lower order of magnitude, and so on.

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[1]Laszlo, The Systems View of the World, p. 61.

2.5 All but the largest systems have suprasystems.[1]

The individual as a social system, for example, forms part of the suprasystem "family," which forms part of the suprasystem "community," which forms part of the suprasystem "culture," which forms part of the suprasystem "society," and so on, up through the suprasystem "universe." Since the universe is, by definition, the ultimate and all-inclusive system, there is no suprasystem to which the universe itself belongs.[2]

2.6 All but the smallest systems have subsystems.[3]

A school system, for example, is composed of interacting elements (the individual schools), each of which is a subsystem in itself, composed of interacting elements (physical plant, student body, faculty, administration), each of which is a subsystem in itself, composed of interacting elements (e.g., the seventh, eighth, and ninth "grades"), each of which is a subsystem in itself, composed of interacting elements (classes), which have further subsystems (dyads), and so on, down through the systems of interacting forces at the sub-atomic level.[4]

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[1] Immegart, "Systems Theory and Taxonomic Inquiry," p. 166.

[2] Laszlo, The Systems View of the World, p. 50.

[3] Immegart, "Systems Theory and Taxonomic Inquiry," p. 167.

[4] Laszlo, The Systems View of the World, p. 61.

2.7 Systems have extension in space-time.[1] According to Roy Grinker,

> A system has a past which is partly represented by its parts, for it develops or assembles from something preceding. It has a present, which is its existence as a relatively stable or what might be called its resting form, and it has a future, that is, functional potentialities. In its space form, structure and dimensions constitute a framework, which is relatively stable and timeless, yet only relatively so, for its constituents change during time but considerably slower than the novel or more active functions of the sytem. To view the change of these functions through time, the frame or background may be artificially considered as stable.[2]

A system such as a small group organized for a specific purpose, for example, has a past represented by the individuals who constitute the group, for the group as an organized whole develops from an aggregate of previously unorganized individuals. The group also has a present, represented in its organizational structure. And it has a future, represented in the functions which its structure allows it to achieve. In any system--for example, the school system in our culture--the organization of the components tends to change less quickly than the functions the system serves. The conventional structure of school, for example, permits equally the teaching of reading or training in the uses of mass media, the development of artists or the production of technicians, and

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[1]Immegart, "Systems Theory and Taxonomic Inquiry," p. 167.

[2]Grinker, Toward a Unified Theory of Human Behavior, p. 371.

so on. The structure of the system, therefore, can for the most part be regarded as time-independent, or as a space-form against which the change in its function over time may be observed.

2.8 All systems tend toward a state of randomness and disorder, the ultimate of which is entropy, or inertia.[1] In isolated (or closed) systems--that is systems which do not exchange energy in any form (including information) with larger systems, and whose total energy resources are therefore confined to the system itself--progress toward randomness and disorder (the most probable distribution of energies in the system) is direct and unimpeded. Open systems, however--that is, systems in interaction with their environments--can, by virtue of their special properties (defined below), temporarily reverse the tendency to inertia.[2] Nevertheless, since the ultimate system within which all other systems function (the universe) is a closed system (having, by definition, no environment with which to interact), all systems, open or closed, must eventually arrive at a state of inertia.[3]

Laszlo provides, as an illustration of this principle, the example of a house:

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[1]Immegart, "Systems Theory and Taxonomic Inquiry," p. 167.

[2]Ibid., p. 168.

[3]Laszlo, The Systems View of the World, p. 36.

> A house with a full tank of heating oil and a good supply of electricity is so organized that it has energy available to heat and light itself and operate a number of electric appliances. But the heating oil (as well as the electricity stored in the batteries) can be exhausted, and in time the house will grow cold and dark. Hence most houses are supplied with regular deliveries of fuel oil and with a continuous input of electricity from a power source. Then the process of running down is postponed, but eliminated. For now the house needs to import its working energies from the outside, and it is a question of how long the outside supplies last. . . . Although some (such as nuclear energies) may be available for a very long time, the point is that no energies are given in limitless supply. Eventually, all the free energies available on the surface of the earth can be used up, and then the house becomes cold and dark with finality. The house as an isolated system would run down rather quickly. The house coupled to the power supplies of a continent forms a system of a much vaster kind, with correspondingly longer life expectancy. And a house coupled with the earth-sun system is a very vast system, with tremendous reserves of energies. But all such systems run down eventually, however long it may take.[1]

3.0 Definitions of Open System and Open System Properties

3.1 Open systems exchange energy and information with their environment.[2]

The human organism, for example, is an open system which takes in food, water, and air from its environment, converts them into energies used to maintain the system, and gives off waste products which are themselves sources of energy for other systems which share the same environment.[3] All other

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[1] Ibid., pp. 35-36.

[2] Von Bertalanffy, General System Theory, p. 39.

[3] Laszlo, The Systems View of the World, p. 40.

natural systems (as distinct from artificial systems such as clocks, cars, and other machines), with the exception of the universe, are open systems.[1] Machines may be open or closed systems, depending on whether or not they are connected (via human agency) with larger systems.[2]

3.2 Open systems tend to maintain themselves in steady states.[3]

A steady state may be defined as "the particular configuration of parts and relationship which is maintained in a self-maintaining and repairing system. It is a state in which energies are continually used to maintain the relationship of the parts and keep them from collapsing in decay. This is a dynamic state, not a dead and inert one."[4]

Man is an example of an open system in a steady state, and so is each of the subsystems that compose his physiological organization.[5] Despite the fact that each of the cells that compose, say, the heart, die and are replaced by new ones, the heart as a whole maintains the particular configuration of parts and relationships that allow it to function as a system. Social organizations such as universities or businesses are also open systems in steady states.[6] The student body in a

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[1] Ibid., pp. 23, 37.

[2] See, for example, Laszlo's illustration of the house as system, supra.

[3] Immegart, "Systems Theory and Taxonomic Inquiry," p. 174.

[4] Laszlo, The Systems View of the World, p. 37.

[5] Ibid.

[6] Ibid., pp. 9-10.

university usually goes through a complete turnover every four years, and the faculty and administration may be replaced completely in twenty, but the institution as a whole retains the particular configuration of parts and relationships necessary to keep the system running.

3.3 Open systems maintain themselves in a steady state not only through their interaction with suprasystems, but through the dynamic interaction of functional subsystems.[1]

The steady state of the human organism, for example, depends not only on its importing energy from its external environment (in the form of food, for example), but on the dynamic interaction of such functional subsystems as the stomach, pancreas, liver, kidneys, intestines, circulatory system, heart, and lungs. The steady state of a university can only be maintained through the dynamic interaction of subsystems such as the faculty, student body and administration.

3.4 Open systems maintain their steady states in part through feedback processes,[2] in which the performed action of the system (output) is reported back to a central regulating apparatus as new input.[3] Feedback processes give systems the property of being able to adjust future conduct by past performance.[4]

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[1]Immegart, "Systems Theory and Taxonomic Inquiry," p. 174.

[2]Ibid.

[3]Norbert Wiener, The Human Use of Human Beings: Cybernetics and Society, Discus Books (New York: Avon Books, 1967), pp. 35-36, 39.

[4]Ibid., p. 47.

Norbert Wiener provides the following example of feedback in human behavior:

> If I pick up my cigar, I do not will to move any specific muscles. Indeed in many cases, I do not know what those muscles are. What I do is turn into action a certain feedback mechanism; namely, a reflex in which the amount by which I have yet failed to pick up the cigar is turned into a new and increased order to the lagging muscles, whichever they may be. In this way, a fairly uniform voluntary command will enable the same task to be performed from widely varying initial positions, and irrespective of the decrease of contraction due to fatigue of the muscles. Similarly, when I drive a car, I do not follow out a series of commands dependent simply on a mental image of the road and the task I am doing. If I find the car swerving too much to the right, that causes me to pull it to the left. This depends on the actual performance of the car, and not simply on the road; and it allows me to drive with nearly equal efficiency a light Austin or a heavy truck, without having formed separate habits for the driving of the two.[1]

3.5 Open systems are self-regulating; they adapt to changes in their environment in a way that is favorable to the continued operation of the system.[2]

Laszlo provides the following example of self-regulation, from biology:

> The most remarkable organic self-regulation phenomenon is the process known as "homeostasis." The term, coined by Cannon in 1939, refers to the precise regulative mechanisms of warm-blooded creatures. Their body temperature is maintained constant, notwithstanding variations in the surrounding medium, and so is blood pressure, sugar and iron concentration, and a host of other essential substances and conditions.[3]

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[1] Ibid., pp. 37-38.

[2] Hall and Fagen, "Definition of System," p. 23.

[3] Laszlo, The Systems View of the World, p. 41.

3.6 Open systems tend toward equilibrium--a state of dynamic balance--but by their natural ability to capitalize on their environments can exhibit negative entropy--a tendency toward increasing order, differentiation, and complexity.[1] This means that, in response to changing conditions in the environment which cannot be offset by adjustments based on the existing structure, open systems import free energies from their environments and use them, not merely to maintain themselves, but to evolve new structures and functions.[2]

Laszlo cites as the primary example of negentropic change in biological organisms the process of phylogenesis--meaning the evolution of the species, and not just their individual members, from one generation to the next. Negentropic change in the human species is reflected not only in biological evolution, but in technological evolution as well (for example, the development of such novel structures as housing, transportation, and information systems).[3] Examples of negentropic change in human social systems are the development of structures such as schools, legal systems, health care systems, and other

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[1]Immegart, "Systems Theory and Taxonomic Inquiry," p. 174.

[2]Laszlo, The Systems View of the World, p. 47.

[3]Ibid.

formal institutions to serve specialized functions.

3.7 Open systems exhibit progressive segregation--a change in their relational structuring over time, corresponding to growth, characterized by increasing division into subsystems and sub-subsystems which tend to display increasing autonomy over time.[1]

In embryonic development, for example, a germ cell passes from a state of equipotentiality to a state where it behaves like a mosaic or a sum of regions which develop independently into definite organs with specialized functions of their own.[2] A similar process occurs in social systems. In a social organization such as a college, for example, growth is accompanied by the splitting up of the organization into subsystems (departments, for example) which operate with increasing autonomy (the growth of a department, for example, does not necessarily affect the operation of the entire system) and serve increasingly specialized functions (training in a specific discipline, for example).

3.8 Open systems exhibit progressive mechanization.[3] This means that, as the whole becomes differentiated into in-

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[1]Hall and Fagen, "Definition of System," p. 22.

[2]Von Bertalanffy, General System Theory, p. 69.

[3]Immegart, "Systems Theory and Taxonomic Inquiry," p. 174.

creasingly independent parts, the parts become fixed with respect to a certain action or function, and the intial potential of the whole for alternative patterns of development decreases.[1]

In the initial stages of embryonic development in organisms, for example, any cell can assume any function. As growth proceeds, however, different complexes of cells form increasingly independent subsystems, each with increasingly differentiated functions or specialized performances--for example, the development of a particular organ, such as the heart. Once specialized subsystems have developed, the cells which make it up can no longer assume alternative functions, and the whole loses its equipotentiality. As a consequence, the more parts are specialized, the more they are irreplaceable, and loss of parts may lead to the breakdown of the whole system.[2]

3.9 Open systems exhibit progressive systematization--a change in relational structuring over time characterized by "strengthening of previous relations among the parts, the development of relations among parts previously unrelated, the gradual addition of parts and relations to a system, or

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[1]Von Bertalanffy, <u>General System Theory</u>, pp. 69-70.

[2]<u>Ibid</u>.

some combination of these changes."[1] In open systems, progressive segregation (3.7), progressive mechanization (3.8), and progressive systematization may occur simultaneously or sequentially.[2]

In living organisms, for example, the progressive segregation and mechanization of various subsystems (e.g., heart and lungs) is accompaned by progressive systematization of the whole through the development of the central nervous system. In social organizations, such as a college or university, progressive systematization (for example, establishment of relational mechanisms such as university senates or faculty councils empowered to regulate certain of the relations between various subsystems) may occur simultaneous with progressive segregation and mechanization or subsequent to progressive segregation.

3.10 Open systems exhibit equifinality:[3] the same final state or "goal" may be reached from different initial conditions or in different ways.[4] (Some systems theorists, like von Bertalanffy, refer to this as the "teleological principle" of open systems.)[5]

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[1]Hall and Fagen, "Definition of System," p. 22.

[2]*Ibid.*, p. 23.

[3]Immegart, "Systems Theory and Taxonomic Inquiry," p. 174.

[4]Von Bertalanffy, *Robots, Men and Minds*, p. 74.

[5]Von Bertalanffy, *General System Theory*, pp. 44-46.

As von Bertalanffy points out,

> A famous example comes from experimental embryology: a normal ovum, e.g., of the sea urchin, a part of an ovum, a half, a quarter or even an eighth of it, two ova fused, etc., may yield the same result, a normal sea urchin larva. . . . Similarly, a growing organism may arrive at the same final state--a certain species-specific adult size--from different initial sizes at birth, or after disturbances or temporary inhibition of the growth process.[1]

Examples of equifinality may be found in social organizations, as well. No matter how different the initial conditions may be in the establishment of a school, for example, all schools which attain a steady state exhibit similar characteristics--e.g., assign differentiated functions to students, teachers, and administrators, organize time in a particular way, establish criteria for evaluating students, and so on.

4.0 Methodological Principles of the Systems Approach

4.1 The formulation of theory for any set of systems may be approached in two ways. The first is to look over the empirical universe and to pick out certain general phenomena which are found in many of the specific systems which constitute the set, and to build up general theoretical models relevant to these phenomena. The second is to arrange the systems which constitute the set in a hierarchy

[1]Von Bertalanffy, Robots, Men and Minds, p. 74.

based on the complexity of their basic components, and to develop theories at a level of abstraction appropriate to each. These two approaches are complementary and should both be employed in the formulation of general theories.[1]

4.2 A systems analysis of a complex phenomenon may focus on the structural properties of the subject system (i.e., the identification of its components, their relationship to one another and to the whole, and the relationship of the system to suprasystems),[2] on the processes through which subsystems, system, and suprasystem interact,[3] on the behavior of the system as a whole over time (i.e., growth, progressive segregation, progressive mechanism, progressive systematization, etc.),[4] or on any combination of these system characteristics.

4.3 The description of a system at one level is generally inadequate for the description of its subsystems and suprasystem. Consideration of a subsystem or suprasystem entails a new set of relationships in general. The behavior of subsystems and suprasystems may not be analogous with that of the original system.[5]

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[1]Kenneth E. Boulding, "General Systems Theory--The Skeleton of Science," General Systems, I (1956), p. 13.

[2]Immegart, "Systems Theory and Taxonomic Inquiry," pp. 169-170.

[3]*Ibid.*, pp. 170-173.

[4]*Ibid.*, pp. 173-175.

[5]Hall and Fagen, "Definition of System," p. 20; see also Anatol Rapoport, Operational Philosophy: Integrating Knowledge and Action (New York: Harper & Brothers, 1953), p. 212.

4.4 In the analysis and description of complex phenomena, the system and its environment (subsystem and suprasystem) must be taken as a set. This means that the description of a system must make reference to its subsystems, their significant properties, their relationship to one another and to the whole, and the relationship of the system to its suprasystem.[1]

4.5 As a conceptual tool, a model of a system should serve an analytical function.[2] This means that it specifies the component parts or aspects of a complex phenomenon, and some of the interrelationships among those parts, so as to permit directed observations of the relevant characteristics of the system. The analytical utility of a system model depends on the extent to which 1) it permits observations of the system which are useful for the purposes of the observer, 2) its definitions of components and relationships are precisely formulated, and 3) its definitions of components and relationships have empirical reference.

4.6 As a conceptual tool, a model of a system should serve an organizing function.[3] This means that it provides a framework in which existing data on the characteristics of a complex

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[1]Grinker, Toward a Unified Theory of Human Behavior, p. 37.

[2]Ibid., p. 373.

[3]Rapoport, Operational Philosophy, p. 207; and Karl W. Deutsch, "On Communication Models in the Social Sciences," Public Opinion Quarterly, XVI (1952), p. 360.

phenomenon can be classified so as to suggest new questions and generalizations about the system under investigation. The organizing power of a system model depends on 1) the precision with which its categories for organizing data are defined, 2) the extent to which existing data can be accommodated within the framework of the model, and 3) the extent to which the organization of data it directs generates new questions and generalizations about the system.

4.7 As a conceptual tool, a model of a system should serve an explanatory function.[1] This means that it accounts for the grossly observable characteristics of a system by postulating the existence of particular components in particular relations within the system. The utility of a system model may be judged by the number of gross observations it explains.

4.8 As a conceptual tool, a model of a system should serve a heuristic function.[2] This means that the representation of the components, properties, and relations in a system should give rise to new questions about the system. The heuristic power of a model may be judged by the number of new questions to which it gives rise.

4.9 In its most rigorous form, a model of a system should serve a predictive function.[3] This means that the assumptions implicit

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[1]Rapoport, Operational Philosophy, p. 207; and Deutsch, "On Communication Models," p. 360.

[2]Rapoport, Operational Philosophy, p. 207; and Deutsch, "On Communication Models," p. 361.

[3]Rapoport, Operational Philosophy, pp. 207, 211; and Deutsch, "On Communication Models," p. 361.

in the model can be used as the basis for formulating empirically verifiable statements about the outcome of events not yet observed. The predictive utility of a model depends on the specificity with which the properties of the subsystems and their relations in a system are defined, and the value of the model as an empirical tool may be judged by 1) the specificity of the predictions it permits, and 2) the success of those predictions.

4.10 In its most rigorous form, a model of a system serves a measuring function.[1] This means that it enables the observer of a system to quantify notions which had theretofore been only qualitative. The measuring power of a model depends on the extent to which it suggests quantitative or mathematical definitions of the components, properties, and relationships it postulates, and the value of the model as an empirical tool may be judged by the extent to which it permits quantitative predictions.

The principles outlined above constitute, in sum, the way of looking at the world known as the systems perspective. They also suggest certain criteria for reviewing and evaluating representations of the world, or models. These criteria, or guidelines for the review and

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[1]Rapoport, Operational Philosophy, pp. 207, 211; and Deutsch, "On Communication Models," p. 361.

evaluation of models, may be summarized in the form of a list of questions which can be applied to any model in an effort to determine its strengths and weaknesses as a representation of a system. Such a list is presented below. For the sake of convenience, the questions which comprise the list are grouped in two categories--questions regarding the form of the model and questions regarding its functions--and each question is keyed, by the numbers in parentheses at the end of the question, to the systems principles from which it derives.

Systems Guidelines for the Review and Evaluation of Models

1.0 Form of the Model

- 1.1 Does the model identify the components (elements) of which the system is composed? (SP 1.3, 1.4, 2.1)
- 1.2 Does the model identify the relations among the components? (SP 1.3, 1.4, 2.1)
- 1.3 Are the components of the system represented as standing in one-way, linear relationships or as parts in mutually qualifying interaction? (SP 1.1, 2.3, 3.3)
- 1.4 Does the model identify the functions of each component in the system as a whole? (SP 3.3, 4.4)
- 1.5 Does the model describe the subsystems of which each component is composed? (SP 2.4, 2.6, 3.3, 4.4)
- 1.6 Is the description of elements and relations in the subsystems different from the description of elements and relations in the original system, or is one description assumed to be

adequate for all levels of the system? (SP 4.3)

1.7 Does the model identify the suprasystem with which the original system interacts? (SP 2.2, 2.5, 3.1, 3.3, 4.4)

1.8 Does the model indicate any effects on the system of changes in its suprasystem? (SP 2.2, 2.5., 3.1, 3.3, 4.4)

1.9 Does the model indicate any effects on the suprasystem of changes in the system? (SP 2.2, 2.5, 3.1, 3.3, 4.4)

1.10 According to the evidence available from observations of the system under investigation, does the model describe all the significant variables in the environment of the system? (SP 2.2, 4.4)

1.11 Does the model include reference to the properties of the system as a whole over time (e.g., maintenance of a steady state, adaptation, growth, progressive segregation, etc.)? (SP 3.2, 3.5, 3.6, 3.7, 3.8, 3.9)

1.12 Does the model include reference to the processes--e.g., feedback--through which the components of the system interact? (SP 3.4, 4.2)

2.0 Functions of the Model

2.1 Does the model serve an analytical function? For what purposes are the observations it directs useful? Are the definitions of components and relationships precisely formulated? Do the definitions of components and relationships have empirical reference? (SP 4.5)

2.2 Does the model serve an organizing function? Are the categories for organizing data precisely defined? How much of the existing data regarding the behavior of the system in question can be accommodated within the framework provided by the model? Does the organization of the data directed by the framework of the model generate any new questions or generalizations about the system? (SP 4.6)

2.3 Does the model serve an explanatory function? What gross observations about the behavior of the system do the postulated components and relations in the system explain? What observations does the model not explain? (SP 4.7)

2.4 Does the model serve a heuristic function? To what new questions about the system does the model give rise? (SP 4.8)

2.5 Does the model serve a predictive function? Are the predictions it permits empirically verifiable? How specific are the predictions the model permits? How frequently have predictions made on the basis of assumptions implicit in the model been accurate? (SP 4.9)

2.6 Does the model serve a measuring function? Does it suggest a means by which qualitative descriptions may be expressed quantitatively? To what extent does it permit quantitative predictions? (SP 4.10)

The questions listed above, along with the questions derived from the principles of media ecology (see Chapter 5), were used as general guidelines for the review and evaluation of the communication models selected for the study (see Chapter 6), as well as for the evaluation of the integrated models proposed at the conclusion of the analysis (see Chapter 8).

CHAPTER 5

MEDIA ECOLOGY: BACKGROUND, PRINCIPLES, AND GUIDELINES FOR MODELS

While media ecology is not nearly so well developed as general systems theory--as a discipline, perspective, method of research, or anything else--the two fields have certain characteristics in common. Like general systems theory, for example, media ecology has its origins in the twentieth-century developments in science reviewed in Chapter 3. Where systems theory grew out of the application of those developments in the study of living organisms, however, media ecology grew out of their application in the development of technology. Einstein's Photoelectric Law, it must be remembered, did not result simply in a shift in the philosophy of science; it also resulted in the invention of television. Quantum physics produced, along with the principles of indeterminancy and complementarity, the atomic bomb. What twentieth-century science produced, in short, was not just a knowledge explosion, but a technological explosion as well--and it is an open question which of the two will have the most far-reaching effects.

It is a point worth noting that the question implied in the foregoing sentence--that is, What will be the long-range effects of technology on civilization?--is a relatively new one. This is not to say that intelligent men never raised it before 1945; Socrates, in fact, speculated (gloomily) on the effects of writing on culture roughly 2400 years before Harold Innis or Marshall McLuhan appeared on the scene.[1] But it is only in the last few years that such speculations have come to occupy the sustained attention of serious men. There are primarily two reasons for this. The first is that, until 1945, the technological environment was for the most part invisible to its inhabitants. As McLuhan likes to say, whoever discovered water, we know it wasn't a fish--by which he means that we are least likely to notice those aspects of our surroundings in which we are most deeply immersed. We are unlikely to notice them, that is, until something goes wrong. The technological environment became visible, in the years following 1945, because it began to cause problems that could not be ignored. The political effects of technology--the arms race, the Cold War, the omnipresent threat of an ultimate nuclear catastrophe set off by accident or design--were among the first of its consequences to come to attention. Then its physical consequences--smog, water pollution, noise--began to appear. And finally, some of the more subtle social and psychological effects of technology came to be recognized. Cars and jet planes increased the mobility of the population, decreased the unity of the extended family. Electrical appliances--and reliable contraceptives--left women with fewer chores and children to tend at home, more time to ponder their roles and experience the beginnings of frustration with their lot in life. The nuclear family began to show signs of stress. Children raised on television sets began

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[1]Several significant passages in Plato's Phaedrus express Socrates' hostility to the printed word.

to find schools dull and tedious, and books not worth learning how to decipher. The more problems emerged, the more visible the technological environment became, and the more visible it became, the more it received the attention of sociologists, psychologists, anthropologists, and technologists in every field.

The study of an environment, however, no matter how visible it may be, demands something more than the efforts of specialists working, each within his own discipline, on those aspects of the whole which are accessible to his particular instruments and techniques. It demands, as well, the availability of a point of view from which the relationships among the parts of the environment, and the relationships among the contributions of different specialists to an understanding of those parts, can be seen. The rigid compartmentalization of science which characterized the Newtonian era, and the relative inefficiency of information storage, retrieval, and transmission processes in the pre-modern world, inhibited the evolution of the point of view necessary for the systematic study of environments, technological or otherwise. But in the years following World War II, both the new world view of science and the new technologies for the rapid and wide-scale dissemination of information across disciplinary boundaries provided the context in which such a perspective could emerge.

It is against this background--the growing visibility of the technological environment and the development of an interdisciplinary perspective from which to view it--that media ecology has begun to take shape in recent years. As a systematic field of inquiry, it is still in its infancy and not as yet very well defined. The term "media ecology" itself was first employed in November of 1968, at the annual meeting of the National Council of Teachers of English in Milwaukee, Wisconsin, where Neil Postman used the term in a major address whose purpose was to suggest a new direction for the teaching of English. (The speech was subsequently published in the book High School 1980, in 1970.)[1] In coining the term, however, Postman pointed out that he was not inventing a non-existent field, but simply giving a name to the kinds of inquiries in which a number of scholars--dating back to Lewis Mumford, in 1945[2]--were already engaged. In addition to Mumford, he cited as examples of practicing media ecologists such people as Harold Innis, Peter Drucker, Jacques Ellul, MarshàllMcLuhan, Edmund Carpenter, David Riesman, Norbert Wiener, Ray Birdwhistell, and several others.[3]

Since 1968, studies in media ecology have been formalized in a number of colleges and universities, and even in a few secondary schools.[4] The first formal program in media ecology was established in the School of Education at New York University in 1971. At roughly the same time,

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[1]Neil Postman, "The Reformed English Curriculum," in High School 1980: The Shape of the Future in American Secondary Education, ed. by Alvin C. Eurich (New York: Pitman Publishing Corporation, 1970), pp. 160-168.

[2]Lewis Mumford, Technics and Civilization (London: George Routledge & Sons, Ltd., 1945).

[3]Postman, "The Reformed English Curriculum," p. 161.

[4]So far as the investigator was able to determine, the first kindergarten through twelfth-grade media ecology curriculum was established in Cherry Creek, Colorado, in 1969.

Postman and Weingartner published a description of that program in their book The Soft Revolution, with the parenthetical comment, "Local catalogues please copy."[1] Oxford University did just that, offering in the summer of 1971 a program of studies in media ecology which was an exact duplicate of the program as it appeared in the book. Jersey City State College presently offers an undergraduate program in media ecology (which it plans to expand into a graduate program within the next year), as does Stanford University. Both Long Island University and the College of White Plains offer courses in media ecology as well. There are, of course, many other programs in media studies that are not explicitly labeled "media ecology," but whose goals and perspectives are similar to those of the programs identified above. There is, in short, good reason to suppose that media ecology is a subject of growing interest in the scholarly community, and the purpose of this chapter is to specify what, as so far defined, the emerging discipline is about: specifically, what are its basic presuppositions and goals, what are its major principles and some of its hypotheses, what is its subject matter and some of the questions it asks, and what are the guidelines for communication models implied by the principles, subject matter, and questions of media ecology.

Information concerning the presuppositions and goals, principles

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[1]Neil Postman and Charles Weingartner, "A Prospectus for a Ph.D. Program in Media Ecology," in The Soft Revolution: A Student Handbook for Turning Schools Around, A Delta Book (New York: Dell Publishing Co., Inc., 1971), pp. 138-146.

and hypotheses, subject matter and questions of media ecologists was derived from two sources: 1) descriptions of the goals and content of media ecology as an academic program of studies, provided in program descriptions, catalogues, and mimeographed course outlines obtained from the faculties of media ecology at New York University, Stanford University, Jersey City State College, and Long Island University, and 2) the works identified as the "basic literature" of media ecology. To determine what works comprise that literature, the investigator submitted to the faculties of media ecology at each of the aforementioned institutions the bibliography for media ecology currently used in the media ecology program at New York University,[1] along with a letter requesting that each faculty member identify the twenty works on the bibliography which he considers most representative, in sum, of the goals, principles, subject matter, and questions of media ecologists. The letter accompanying the bibliography also asked each respondent to include in his list of twenty works any work which he considered "basic" that did not appear on the bibliography. A total of twenty-one letters and bibliographies were sent out, and thirteen usuable responses were received.

On receipt of the responses, the investigator compiled a list of all the works cited as "basic," deleted from the list any works which are sources for the models selected for analysis (see Chapter 6), and

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[1]Since the NYU program in media ecology has been in effect longer than any other, and has served as the prototype for the newer programs, the NYU bibliography was taken as the most reliable source from which the "basic literature of media ecology" may be derived.

recorded the number of times each remaining work was cited as "basic" on the bibliographies returned by the respondents. The original intent was to take as the basic literature of media ecology the twenty works cited most frequently in the responses. The bibliographies returned, however, did not show as much agreement as expected on the twenty basic works. After references to works containing models selected for analysis were deleted from the "basic" list, sixty-six works remained. Of these, thrity-four were cited three or more times as "basic," and the remaining thirty-two were cited either twice or once. The investigator modifed the original selection plan, therefore, and took as the "basic literature" of media ecology those works cited three or more times on the thirteen returns, thus increasing from the planned twenty to an operative thirty-four the number of works identified as the basic literature of media ecology. The works so identified are listed below.

Work	Number of Citations
Baier, Kurt, and Rescher, Nicholas, eds, Values and the Future. New York: The Free Press, 1969.	6
Bateson, Gregory. Steps to an Ecology of Mind. New York: Ballantine Books, 1972.	6
Birdwhistell, Ray L. Kinesics and Context. Philadelphia: University of Pennsylvania Press, 1970.	5
Boulding, Kenneth E. The Image. Ann Arbor, Michigan: University of Michigan Press, 1956.	5
________. The Meaning of the 20th Century. Harper Colophon Books. New York: Harper & Row, Publishers, 1965.	4

Works	Number of Citations
Bridgman, Percy W. The Way Things Are. Cambridge, Mass.: Harvard University Press, 1959.	4
Broadbent, Donald E. Perception and Communication. New York: Pergamon Press, 1958.	3
Carpenter, Edmund, and McLuhan, Marshall, eds. Explorations in Communication. Boston: Beacon Press, 1966.	10
Carroll, John B. Language and Thought. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.	4
Cassirer, Ernst. Language and Myth. New York: Harper & Brothers, 1946.	5
Dewey, John, and Bentley, Arthur P. Knowing and the Known. Boston: Beacon Press, 1949	4
Dexter, Lewis Anthony, and White, David Manning, eds. People, Society and Mass Communications. New York: The Free Press, 1964.	3
Drucker, Peter F. The Age of Discontinuity. New York: Harper & Row, 1968.	3
Duncan, Hugh Dalziel. Communication and Social Order. London, Oxford, New York: Oxford University Press, 1968.	7
Ellul, Jacques. The Technological Society. New York: Vintage Books, 1964.	11
Fuller, R. Buckminster. Utopia or Oblivion. New York: Bantam Books, 1969.	9
Harvard Program on Technology and Society, 1964-1972. A Final Review. Cambridge, Mass., 1972.	4
Innis, Harold A. The Bias of Communication. Toronto: University of Toronto Press, 1951.	11
Klapper, Joseph T. The Effects of Mass Communication. New York: The Free Press, 1960.	3
Kluckhohn, Clyde. Mirror for Mam. New York: McGraw-Hill Book Company, 1949.	3

Works	Number of Citations
Langer, Susanne K. Philosophy in a New Key. Cambridge, Mass.: Harvard University Press, 1942.	6
Maslow, Abraham H. The Psychology of Science. A Gateway Edition. Chicago: Henry Regnery Company, 1969.	4
McHale, John. The Future of the Future. New York: Ballantine Books, Inc., 1971.	5
McLuhan, Marshall. Understanding Media. New York: McGraw-Hill Book Company, 1965.	11
Mead, Margaret, ed. Cultural Patterns and Technical Change. Mentor Books. New York and Toronto: The New American Library, 1955.	3
Mumford, Lewis. The Myth of the Machine: Technics and Human Development. New York: Harcourt, Brace & World, Inc., 1967.	6
________. The Myth of the Machine: The Pentagon of Power. New York: Harcourt, Brace & World, Inc., 1970.	10
Rosenberg, Bernard, and White, David Manning, eds. Mass Culture. New York: The Free Press, 1956.	
Schramm, Wilbur. The Process and Effects of Mass Communication. Urbana, Ill.: University of Illinois Press, 1949.	5
Smith, Alfred G., ed. Communication and Culture. New York: Holt, Rinehart and Winston, Inc., 1966.	4
Toffler, Alvin. Future Shock. New York: Random House, Inc., 1970.	10
________, ed. The Futurists. New York: Random House, Inc., 1972.	3
Whatmough, Joshua. Language: A Modern Synthesis. A Mentor Book. New York: The New American Library, 1956.	3
Whitehead, Alfred North. Symbolism, Its Meaning and Effect. New York: The MacMillan Company, 1927.	4

After identifying the basic literature of media ecology, the investigator reviewed the works cited, along with the goals-and-content statements of programs in media ecology, and composed a summary of the major presuppositions, goals, principles, hypotheses, subject matter, and questions of media ecology, as represented in the works listed above. That summary is presented, in modified outline form, on the following pages. For the sake of convenience, the material is organized in three categories: basic presuppositions and goals, major principles and hypotheses, and subject matter and questions. Since most of the goals, principles, and questions represented in the summary appear in one form or another in a large proportion of the works identified as basic in the literature of media ecology, representative, rather than comprehensive, references are provided for the entries in the outline.

Media Ecology:

Principles and Subject Matter

1.0 Basic Presuppositions and Goals

1.1 The character and pace of change in the modern world--specifically, of change related to communications technology--is radically different from anything cultures have experienced in the past.[1]

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[1]See, for example, Alvin Toffler, Future Shock (New York: Random House, Inc., 1970), pp. 14-25. Cf. Kenneth Boulding, The Meaning of the 20th Century, Harper Colophon Books (New York: Harper & Row, Publishers, 1965), pp. 1-7.

Media ecologists have often used some variation of a clock metaphor to illustrate this point, as in the following passage:

> Imagine a clock face with 60 minutes on it. Let the clock stand for the time men have had access to writing systems. Our clock would then represent something like 3,000 years, and each minute on our clock 50 years. On this scale, there were no significant media changes until about nine minutes ago. At that time, the printing press came into use in Western culture. About three minutes ago, the telegraph, photograph, and locomotive arrived. Two minutes ago: the telephone, rotary press, motion pictures, automobile, airplane, and radio. One minute ago, the talking picture. Television has appeared in the last ten seconds, the computer in the last five, and communication satellites in the last second. The laser beam--perhaps the most potent medium of communication of all--appeared only a fraction of a second ago.[1]

1.2 Our understanding of communication processes and their effects on our lives has not kept pace with the development of communication technology. Consequently, we are ill-equipped to cope, not only with the communication environments of the future, but with the communication environments in which we function at present.[2]

While none of the works in the basic literature of media ecology offers a precise definition of the term

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[1]From the unpublished goals-and-content description of the Master's program in Media Ecology at New York University; also in Neil Postman and Charles Weingartner, Teaching as a Subversive Activity, A Delta Book (New York: Dell Publishing Co., Inc., 1969), p. 10. Cf. Toffler, Future Shock, p. 15.

[2]See, for example, Toffler, Future Shock, pp. 3-4, and Marshall McLuhan, Understanding Media: The Extensions of Man (New York: McGraw-Hill Book Company, 1964), pp. 4-6.

"communication environment," the concept that communication systems are environments is implicit in most, if not all the works reviewed. Postman comes closest to an explicit definition of the concept of communication environments (although he uses the somewhat narrower term "media environments") in his definition of media ecology:

> Media ecology is the study of transactions among people, their messages, and their message systems. More particularly, media ecology studies how media of communication affect human perception, feeling, understanding, and value; and how our interaction with media facilitates or impedes our chances of survival. The word ecology implies the study of environments--their structure, content, and impact on people. An environment is, after all, a complex message system which regulates ways of feeling and behaving. It structures what we can see and say and, therefore, do. Sometimes, as in the case of a courtroom, or classroom, or business office, the specifications of the environment are explicit and formal. In the case of media environments (e.g., books, radio, film, television, etc.), the specifications are more often implicit and informal, half-concealed by our assumption that we are dealing with machines and nothing more. Media ecology tries to make these specifications explicit. It tries to find out what roles media force us to play, how media structure what we are seeing, why media make us feel and act as we do. Media ecology is the study of communications technology as environments.[1]

1.3 Media ecology takes as its primary goal, therefore, to increase awareness and understanding of the processes of communication and of the effects of complex communication environments--including media, techniques, and technology--on human

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[1]Postman and Weingartner, "A Prospectus for a Ph.D. Program in Media Ecology," p. 139.

perception, feeling, value, and behavior.[1]

There seems to be little concrete agreement in the basic literature of media ecology on the definitions of the terms medium, technology, and technique, although medium is generally used as the most inclusive term, and technology as the most specific. To reflect the widest variety of its uses, the term medium may be defined as "any agent or agency through which two or more discrete elements are linked in an integrated (or transacting) system." Techniques may be defined, after Ellul, as those media which are constituted of a set of procedures.[2] The technique known as "operant conditioning," for example, is a medium which links behavior A to behavior B through a set of procedures. The technique known as "parliamentary procedure" is a medium which links event A to event B through a different set of procedures. The technique known as "Aristotelian logic" is a medium which links statement A to statement B through still another set of procedures. Also after Ellul, a technology may be defined as a medium characterized by a formal, physical structure.[3] Television is a technology, as is an assembly line, a telephone, a car, a computer, a school. Technologies are usually the results,

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[1]Ibid. Cf. The Harvard Program on Technology and Society, 1964-1972, A Final Review (Cambridge, Mass., 1972), pp. 9-11, and Toffler, Future Shock, pp. 379-393.

[2]Jacques Ellul, The Technological Society (New York: Vintage Books, 1964), pp. xxv-xxvi and 1-7.

[3]Ibid.

or products, of technique.

1.4 Communication change is a synergistic, not an additive process. The introduction of a new communication medium, or a change in an existing medium, alters the entire environment--physical, social, and psychological.[1]

This concept follows quite naturally from the definition of communication environments as ecosystems--that is, systems in which every component is related to every other in dynamic interaction. For an instant grasp of the synergistic character of communication change, one need only reflect for a moment on the effects of the introduction into American culture of the micro-transistorized recording device, or "bug." At this particular point in time, it would seem quite clear that the device is in the process of revolutionizing not only the psychology of the culture (e.g., our concepts of privacy), but its social and political structures as well.

1.5 Since communication environments are ecosystems, and media changes are ecological processes, they cannot be understood solely from the point of view of specialists in compart-

[1]See, for example, McLuhan, Understanding Media, Introduction to the Paperback Edition, pp. vii-viii.

mentalized disciplines, but require the attention of generalists with genuinely interdisciplinary perspectives.

Perhaps the clearest statement of this presupposition is to be found in the final report of the Harvard Program on Technology and Society, cited earlier. The study of technology and society, the report points out,

> . . . is a problem area, not an academic discipline, and understanding in the area cannot be effectively pursued within the confines of any single discipline. . . . /It poses/ a class of intellectual problems that demand a multidisciplinary approach because of the nature of the subject matter being inquired into. . . . An effective approach to the latter type of problem calls for more than a simple collection of different scholarly viewpoints; what is needed is a genuine blending of the resources and techniques of various disciplines. It is not enough merely to recognize the interactions among social, economic, physical, and political effects of a given change. Truly multidisciplinary methods must be sought, including development of a common language as well as a special effort at intellectual synthesis to focus diverse aspects of the research. These are problems and methods with which there is as yet little experience, so that their nature and importance are not easily discerned in terms of traditional academic perspectives. . . .[1]

1.6 The goal of media ecology, therefore, is to provide a framework for integrating the diverse perspectives and contributions of specialists in various fields to the study of communication

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[1]Harvard Program on Technology and Society, A Final Review, pp. 4-5.

environments and change. As the editors of the Media Ecology Review put it, in their prospectus for the journal,

> As students of media and communication, we have chosen to take an ecological approach to fields where specialists abound. There is no lack of interest in media and communication on the part of sociologists, psychologists, mathematicians, linguists, journalists, and educational technologists, as their professional journals attest. Our task, as media ecologists, is to draw on their particular insights, integrate them, and use them to fashion new theories about the effects, implications, and processes of media and communication.[1]

1.7 Communications media, techniques, and technology are powerful instruments for the conscious and unconscious manipulation of human behavior. An understanding of the processes through which they work, and of their effects, is the public's best protection against such manipulation. The goal of media ecology, therefore, is to disseminate to the widest possible audience the insights it can provide into the processes and effects of media, technique, and technology.

These presuppositions and goals are implicit in most of the works in the bibliography of media ecology. While the warnings against the manipulations of technology and technique are sounded most clearly, perhaps, in Mumford and Ellul[2] (both of whom have been categorized as "media pessim-

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[1]From the unpublished prospectus for the Media Ecology Review, a publication of the doctoral program in media ecology at New York University.

[2]See, for example, Lewis Mumford, The Myth of the Machine: The Pentagon of Power (New York: Harcourt, Brace & World, Inc., 1970), pp. 330-334, and Ellul, The Technological Society, pp. 115-127.

ists"), the function of media ecology as a "public information service" on the processes and effects of communication and communications technology is given its greatest stress in the prospectus for the Ph.D. program in media ecology at New York University:

> Perhaps the most singular feature of the program will be the students' continuous participation in media criticism. . . . The students will, in effect, monitor our media environment, addressing themselves to the national community. . . . Their object will be to initiate and sustain a serious, informed dialogue with the national community on the interaction between human beings and their communication technology. Our plans require that we reach out as far as possible into the community, so that many different kinds of citizens will look to our students for the most penetrating evaluations of our technological society.[1]

1.8 There is, in the development of any new discipline, a tendency toward elitism--the development of an increasingly specialized language and technique of its own. The effect of such specialization is to render less accessible to "outsiders" the knowledge to which the "insiders" gain access. The goal of media ecology is not to mystify, but to demystify the study of communication processes, products, and effects.[2]

2.0 Major Principles and Hypotheses

2.1 Since different forms of communication are different ways of

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[1]Postman and Weingartner, "A Prospectus for a Ph.D. Program in Media Ecology," p. 143.

[2]Neil Postman, unpublished keynote address, First Conference in Media Ecology, Pawling, N.Y., 1972. Cf. Mumford, The Pentagon of Power, pp. 263-272, and Noam Chomsky, American Power and the New Mandarins (New York: Vintage Books, A Division of Random House, 1969).

encoding reality, the structure (grammar, form) of any communication medium is, in itself, a message which reveals a certain perception of reality.

This is, basically, what McLuhan means by his well-known aphorism, "The medium is the message." Edmund Carpenter puts it somewhat less pithily: "Each medium, if its bias is properly exploited," he writes, "communicates a unique aspect of reality, of truth. Each offers a different perspective, a way of seeing an otherwise hidden dimension of reality. . . . A medium is not simply an envelope that carries any letter; it itis itself a major part of that message."[1]

According to this view, it is the form of the medium, not the content of the message it carries, that dominates our organization of reality. The structure of the printed book, to take one of Carpenter's examples, presents a "reality" that has been divided into static units which can be isolated and analyzed. The structure of television, on the other hand, presents a "reality" in which everything happens at once, in which time cannot be stopped, and in which events are difficult to isolate and analyze.[2]

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[1]Edmund Carpenter, "The New Languages." in Explorations in Communications, ed. by Edmund Carpenter and Marshall McLuhan (Boston: Beacon Press, 1960), pp. 174, 176.

[2]Ibid., pp. 162-166.

This principle has had extensive application in the work of media ecologists, not only to studies in the structure of media such as television, print, LP record, radio, film and the like,[1] but also to studies in the relationship between the structure of language and the perceptions it codifies,[2] and even to studies in art, architecture, and music.[3]

2.2 Every medium of communication has its biases and limitations. The structure of the medium determines the kind of message it can carry.

As Carpenter writes, "a given idea or insight belongs primarily, though not exclusively, to one medium, and can be gained or communicated best through that medium."[4] To take

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[1]See, for example, Harold A. Innis, The Bias of Communication (Toronto: University of Toronto Press, 1951); Marshall McLuhan, Understanding Media, The Mechanical Bride: Folklore of Industrial Man (New York: Vanguard Press, 1951), and The Gutenberg Galaxy: The Making of Typographic Man (Toronto: University of Toronto Press, 1962).

[2]See, for example, Percy Bridgman, The Way Things Are (Cambridge, Mass.: Harvard University Press, 1959); John B. Carroll, Language and Thought (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964); Ernst Cassirer, Language and Myth (New York: Harper & Brothers, 1946); Clyde Kluckhohn, Mirror for Man (New York: McGraw-Hill Book Company, 1949); Susanne K. Langer, Philosophy in a New Key (Cambridge, Mass.: Harvard University Press, 1942); Joshua Whatmough, Language: A Modern Synthesis, A Mentor Book (New York: New American Library, 1956); and Alfred North Whitehead, Symbolism, Its Meaning and Effect (New York: The Macmillan Company, 1927).

[3]See, for example, Susanne K. Langer, Feeling and Form (New York: Charles Scribner & Sons, 1953), and S. Giedion, "Space Conception in Prehistoric Art," in Explorations in Communication, pp. 71-89.

[4]Carpenter, "The New Languages," p. 167.

his examples, the structure of the newspaper, with its juxtaposition of reports from widely separated places and times, is admirably suited to the expression of simultaneity. On the other hand, the newspaper format destroys chronology and lineality. The magazine format "creates a sense of urgency and uncertainty"; it destroys causality. Television "favors simultaneity of visual and auditory images" and communicates true uncertainty; it cannot, on the other hand, produce the sweeping panoramas required for dramatization of the sea, Civil War battles, and the like. The book "was ideally suited for discussing evolution and progress," for these ideas move from point to point along a line, just as does the reader's eye; the book cannot, however, create real uncertainty or simultaneity.[1]

Media ecologists other than Carpenter have applied this principle in the study of different "media biases." McLuhan argues, in "Acoustic Space," for example, that sound is the best medium for expressing and evoking a wide range of feelings, because sound, like feeling, is transient, directionless, and favors no one point of focus.[2] He also advances the hypothesis that every medium has a different _sensory_ bias--

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[1] _Ibid._, pp. 162-179.

[2] Marshall McLuhan, "Acoustic Space," in _Explorations in Communication_, pp. 65-70.

that is, excites a particular sense. (While McLuhan himself is not very clear on the reasoning which leads him to conclude that radio, for example, is a visual medium and television a tactile medium, the principle he is working on seems to be that a medium stimulates that sense or those senses to which it provides no direct stimulus. This suggests that print, then, should be classified as primarily an auditory medium, and film as an olfactory medium--which might explain the popularity of popcorn in movie theatres. This hypothesis of McLuhan's is directly related to another--namely, that the lower the information content of a medium, the greater the involvement it engenders in the audience. Thus, a "hot" medium--one with a heavy information load--provokes a "cool" response from the audience, while a "cool" medium--one with little information--provokes a "hot" response. Neither of these hypotheses is discussed here in detail, because neither finds much general support or attention in the literature of media ecology. They are, however, certainly worth noting here and, in the investigator's opinion, worth more serious attention from media ecologists in the future than they have been given to date.)

One final example of the applications of the principle of media bias in the work of media ecologists can be drawn from the writing of Lawrence K. Frank. In "Tactile Communication," for example, Frank points out that tactilism is the most effective medium for communication in certain interpersonal relations. Since the infant defines his relationship to himself and others primarily through tactile experience, Frank argues, the medium of touch is more effective in the communication of feelings like love, sympathy, reassurance, and warmth than any other medium. On the other hand, a structural limitation of tactilism is that an ojbect must be within touching distance for communication to take place. Consequently, "highly abstract concepts seem to lie outside the range of most tactile messages and probably occur only in such a system as Braille."[1]

2.3 No medium of communication operates in isolation. Every medium affects every other medium.

Some of the most interesting hypotheses of media ecologists derive from this principle. McLuhan, for example, has advanced three which are worth noting here. The first, and most general, is that the "content" of a medium is always an older medium. Thus, the "content" of writing is speech,

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[1]Lawrence K. Frank, "Tactile Communication," in Explorations in Communication, pp. 4-11. Ray L. Birdwhistell also deals at length with the "grammar" of tactile communication and kinesics in general in Kinesics and Context (Philadelphia: University of Pennsylvania Press, 1970). For other writers whose works reflect the principle that the structure of a medium determines its content, see n. 2, 3, and 4 on p. 127.

the "content" of print is writing, the "content" of telegraphy is print, and so on, up to the content of television, which turns out to be, for the most part, either movies or radio. Of course, new media do not simply absorb the older media, they transform them in significant ways, and with significant effects, and such transmedia transformations, all by themselves, are a subject of considerable interest to media ecologists. To return for a moment, though, to McLuhan's other two hypotheses regarding media interactions, the second is that a new medium always competes with older media for the time, money, attention, and loyalties of the culture into which it is introduced, and the competition is always both heated and fierce. A major part of the reason for the ferocity of the fight between the allies of the older medium (print, for example) and the allies of the new (television, for example) is that, as the preceding principle implies, what is at stake is not merely a technology, but the entire life style that the technology implies. (This point will be returned to in the explication of Principles 2.4 and 2.5.) While new technologies are always met with some resistance, on these grounds alone, the struggle between technologies is always most fierce when the new technology performs more efficiently or effectively than the old the same function that the old was designed to serve. When this happens, McLuhan asserts, only one of two outcomes can result--and this is his third hypothesis of media change: When a new technology is introduced into a culture which usurps the function of an older technology, either the older technology will undergo some radical transformation and survive, or it will obsolesce--and be preserved as an art form. As examples of the former event, we have, under the influence of photography, the transformation of painting from "realistic" to "impressionistic," and, under the influence of television, the transformation of the book into paperback and the magazine into a specialized, select-audience publication. As examples of the latter event (the obsolescence of the older medium, and its preservation as "art"), we have the illuminated manuscript, the movies (now "film" or "cinema"), and clothing (now "fashion"), to name just a few.[1]

As noted earlier, a number of media ecologists have devoted considerable interest to identifying the effects of one medium on another. Frank, for example, draws his readers' attention to the relationships between tactile communication and visual and auditory communication. "It seems clear," he writes, "that the infant's reception of verbal messages is predicated in large measure upon his prior tactile experiences. . . . The baby's initial spatial orientation occurs through tactile explorations. Deprivations of such experiences may

[1]The preceding summary of McLuhan's major hypotheses on the interactions between media was derived primarily from Understanding Media. The examples provided, however, are the investigator's.

compromise the infant's future learning, particularly of speech and, indeed, of all symbolic systems."[1] In "Pure Color," Fernand Leger discusses at some length the relationships between color and visual space, and the effects of the interactions between the two on a third medium, architecture.[2] And in "The New Languages," Carpenter speculates on some of the relationships between print, kinesics, and television. "Printing rendered illegible the faces of men," he writes. "So much could be read from paper that the method of conveying meaning by facial expression fell into desuetude. . . . There was no longer need for the subtler means of expression provided by the body. The face became immobile." But the new media, he adds, are returning us to primary modes of expression. "Just as radio helped bring back inflection in speech, so film and TV are aiding us in the recovery of gesture and facial awareness."[3]

McLuhan himself, of course, has much to say on the subject of the effects of one medium on another. In "The Effect of the Printed Book on Language," for example, he argues that "print called for a stylistic revolution. The speeding eye of the reader favored not shifting tones but steadily maintained

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[1]Frank, "Tactile Communication," p. 8.

[2]Fernand Leger, "Pure Color," in Explorations in Communication, pp. 96-99.

[3]Carpenter, "The New Languages," pp. 170-171.

tone, page by page, throughout the volume. Prose became urbane, macadamized." Print also had its effects on poetry. Until the 17th century, "verse had no status at all as recited. It had to be sung. Owing to print, spoken verse became popular on stage. Song is speech slowed down and adapted to a single tone or pitch. Print made possible the rapid reading of verse. In speeding up song, print fostered oratorically delivered poetry." According to McLuhan, print had an overwhelming effect on the structure of language, as well as on style. The delicate shades of meaning expressed in preliterate speech by complex verb tenses and inflectional endings were sacrificed to the explicitness of "one clear meaning" in print. With the advent of the new media, however, we return to acoustic space: "Now behind us are those unimaginative centuries that strove to eliminate ambiguity and suggestion from language in the interests of the 'one clear meaning.' Recovery of auditory imagination with its awareness of the total life of words has banished the tyranny of the visual, printed forms of language with their intolerance of complex modes."[1]

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[1]McLuhan, "The Effect of the Printed Book on Language," Explorations in Communication, pp. 125-135. Other media ecologists whose work reflects the principle that one medium of communication affects other media are, for example, Birdwhistell, Kinesics and Context; Lewis Anthony Dexter and David Manning White, eds., People, Society, and Mass Communication (New York: The Free Press, 1964); Innis, The Bias of Communication; Langer, Feeling and Form; Bernard Rosenberg and David Manning White, eds., Mass Culture (New York: The Free Press, 1956).

2.4 Every medium of communication affects the psychology of the individual and the group using that medium.

This principle is, quite clearly, an axiom of the principle that different media of communication express different perceptions of reality. What it adds to that principle is that, once an audience unconsciously internalizes the structure of any medium (be it print, language, radio, television, film, or any other), it will perceive reality only as it conforms to that structure (or code). Carpenter and McLuhan refer to this principle in their Introduction to Explorations in Communication when they write that "the analytic modes of literacy . . . create a habit of perception and analysis that deliberately, and by organized means, ignores all but one thing at a time. The price we pay is existing personally and socially in a state of almost total subliminal awareness."[1] McLuhan expands on this theme in comparing the perceptual biases of preliterate and literate cultures: "In many preliterate cultures, the binding power of oral tradition is so strong that the eye is subservient to the ear. In our society, however, to be real, a thing must be visible, and preferably constant. We trust the eye, not the ear. Not

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[1]Carpenter and McLuhan, Introduction, Explorations in Communication, p. xi.

since Aristotle assured his readers that the sense of sight was 'above all others' the one to be trusted, have we accorded to sound a primary role."[1] Perhaps the clearest expression of this principle, however, comes from Dorothy Lee, who prefaces an extensive analysis of two different cultures with the statement that, "Basic to my investigation is the assumption that a member of a given society--who, of course, codifies experienced reality through the use of language and other patterned behavior characteristic of his culture--can actually grasp reality only as it is presented to him in this code."[2]

2.5 Different media of communication have different effects on the organization of societies and of all their institutions.

This is perhaps the most dominant principle in all of the works in the basic literature of media ecology. A handful of examples of its applications in the work of different media ecologists is provided here simply to suggest its significance and some of the hypotheses derived from it. The best known of these, perhaps, is Carpenter's and McLuhan's hypothesis

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[1]McLuhan, "Acoustic Space," p. 65.

[2]Dorothy Lee, "Lineal and Non-Lineal Codifications of Reality," in Explorations in Communication, p. 136. The principle that media of communication affect the psychology of their users is implicit in all the works on the bibliography of media ecology, but is most explicit in Bridgman, The Way Things Are; Broadbent, Perception and Communication; Carroll, Language and Thought; Innis, The Bias of Communication; Kluckhohn, Mirror for Man; Langer, Philosophy in a New Key and Feeling and Form; McLuhan, Understanding Media; Mead, Cultural Patterns and Technical Change; Mumford, The Pentagon of Power; and Toffler, Future Shock.

that electronic media have altered the structure not only of individual institutions and societies, but of the entire network which they comprise: "Postliterate man's electronic media," they argue, "contract the world to a village or tribe where everything happens to everyone at the same time: everyone knows about, and therefore participates in, everything that is happening the minute it happens. Television gives this quality of simultaneity to events in the global village. . . . This simultaneous sharing of experiences as in a village or tribe creates a village or tribal outlook, and puts a premium on togetherness."[1]

Not all media ecologists take as broad a perspective on media and social structure as do Carpenter and McLuhan. David Riesman focuses, for example, on the differences in social structure between cultures that depend entirely on the spoken word and those that depend on print. In the preliterate culture, Riesman observes, "there is a tendency for the old to have an exalted place as the storage banks of experience and entertainment," while in literate cultures, writing "tends to foster hierarchies of skill rather than age." The oral tradition tends to keep people together; print is "the isolating medium par excellence." Among other social effects which Riesman

[1] Carpenter and McLuhan, Introduction, Explorations in Communication, p. xi.

attributes to print is the rise and influence of the middle class--"the time-attentive, the future-oriented, the mobile." He cites the role of the 19th-century novel in fostering the conception of life implicit in the notion of a career. The dramatic structure of the novel," he argues, "with its protagonist, its interest in motive, its demand on the reader that he project himself into the experiences portrayed . . . on many occasions helped prepare individuals for their careers in a disorienting world of rapid industrialization and urbanization--where fictional moves and actual ones were not so unlike, and life and art could almost imitate each other."[1]

Gilbert Seldes focuses his attention on the effects of print on the development of democracy in the United States. Having no obsolete technologies to do away with, Seldes argues, the United States took the greatest advantage of print. With print came communication that could be endlessly duplicated and, with the development of high-speed presses and rapid transportation systems, easily and cheaply distributed. The availability of information at low cost to large numbers of people made it possible to establish mass education, and education, made it possible to establish in the United States a social structure whose political life was based on public opinion--

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[1]David Riesman, "The Oral and Written Traditions," in <u>Explorations in Communication</u>, pp. 109-116.

in other words, a working democracy.[1]

Arthur Gibson is another media ecologist who has focused on the relationship of media to political structures. One reason why the press, in the Soviet Union, reinforces socialism, while the press in the United States reinforces individualism, he hypothesizes, is that the United States was a book culture for decades before the press revolution took effect. The book, created for minorities of varying sizes, isolated the reader and made communication a person-to-person relationship between author and reader. "After centuries of book habitude," therefore, "the press merely intensified our personal interests." The collective form of the press (one person speaking to many) was counteracted by our book-fostered concern for the individual point of view. In the Soviet countries, however, the press revolution burst with full force on "a culture that was still feudally socialized," with no backlog of book orientation to mitigate the collective emphasis of the newspaper. The press in the Soviet Union, therefore, was taken seriously as a daily collective educator, reinforcing a socialistic, and later communistic, political structure.[2]

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[1]Gilbert Seldes, "Communications Revolution," in Explorations in Communication, pp. 196-199.

[2]Arthur Gibson, "The Soviet Press," in Explorations in Communication, pp. 200-206.

These are, of course, only a few examples of the applications media ecologists have made of the principle that communications media have wide-ranging effects on the structure of society and its institutions. They should suffice, however, to indicate something of the scope of the principle and the variety of hypotheses to which it has led.[1]

3.0 Subject Matter and Questions

The subject matter of media ecology may be described at three different levels of abstraction. At the highest level, it consists of the relationships and processes media ecologists are concerned to study in all communication systems. These are identified in items 3.1 through 3.3 below. At a somewhat lower level of abstraction, the subject matter of media ecology consists of the specific systems in which media ecologists are concerned to observe those relationships and processes. These are identified in items 3.4 through 3.12, below. And at the lowest level of abstraction, the subject matter of media ecology consists of the questions media ecologists are concerned to ask about the relationships and processes which concern them within the context of specific systems. Examples of these questions are provided under each of the items 3.4 through 3.12.

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[1] As noted earlier, this principle is reflected in almost all the works in the literature of media ecology. It is given particularly pointed expression and application, however, in the works of Boulding, Carpenter and McLuhan, Dexter and White, Drucker, Duncan, Ellul, Fuller, the Harvard Program, Innis, Klapper, Mead, Mumford, Rosenberg and White, Smith, and Toffler.

3.1 Media ecology takes as its general subject matter the interactions between the structure of a medium, a technology, or a technique, and its content.[1]

The structure of a medium, technique, or technology refers to those of its characteristics which remain constant despite change in its constituent parts. One of the structural characteristics of television, for example, is that it organizes time in thirty, sixty, or ninety-minute (or second) blocks. This characteristic remains constant in spite of the change in the subject matter to which the time slots are allocated. The content of a medium refers to the composition of the constituents that occupy its structure at a specific time.

3.2 Media ecology takes as its general subject matter the interactions between the structure of a medium, technique, or technology, and its functions.[2]

The functions of a medium may be defined as the behaviors, relations, outcomes, goals, and effects its structure permits. The functions of a medium include not only its actual effects, but its potential effects, as well.

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[1] See, for example, Carpenter and McLuhan, Explorations in Communication; McLuhan, Understanding Media; and Innis, The Bias of Communication.

[2] See, for example, Carroll, Language and Thought; Innis, The Bias of Communication; McLuhan, Understanding Media; Ellul, The Technological Society; and Mumford, The Pentagon of Power.

3.3 Media ecology takes as its general subject matter the processes of perceiving, coding, meaning-making, valuing, and change.[1]

Perceiving may be defined generally as the process by which data is selected for attention, organized in some pattern, and stored or acted upon. Coding may be defined generally as the process by which some stimulus is converted into another form having regular structural characteristics of its own. Meaning-making may be defined generally as the process of attributing some specific significance to codes. Valuing refers generally to those processes by which ends are hierarchically ordered in terms of one's preferences for alternative courses of action. And change refers to all the processes involved in producing a recognizable (although not necessarily outwardly observable) difference in any process, characteristic, or set of relations in a system.

3.4 Media ecology takes as its subject matter the interactions between an individual and the "realities" outside his skin.[2]

How does the structure of the human nervous system affect perception? What physiological and psychological factors in the organism affect the selection of data for notice? Do

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[1]See, for example, Broadbent, Perception and Communication; Whitehead, Symbolism: Its Meaning and Effect; Carroll, Language and Thought; Baier and Rescher, Values and the Future; and Toffler, Future Shock.

[2]See, for example, Broadbent, Perception and Communication; Dewey and Bentley, Knowing and the Known.

different senses organize "reality" differently? Do different people have different "sensory biases"? What environmental factors influence the perception process? What are the effects on perception of past experience? How do perceptions change?

3.5 Media ecology takes as its subject matter the interactions between coding systems and "reality."[1]

What are the structural characteristics of different coding systems? Do different coding systems organize "reality" differently? Do some coding systems have greater structural correspondence with reality than others? Which coding systems codify which aspects of reality? Do different codes have different kinds of connections with reality?

3.6 Media ecology takes as its subject matter the interactions between human behavior and coding systems.[2]

What are the effects of different coding systems on human perception? Do different coding systems serve different functions in relation to human behavior? Do changes in coding systems produce changes in human perception and behavior? What are the variables that affect the meanings an individual will assign to a given symbol or sign?

3.7 Media ecology takes as its subject matter the interactions between one individual and another.[3]

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[1]See, for example, Birdwhistell, Kinesics and Context; Langer, Philosophy in a New Key.

[2]See, for example, Birdwhistell, Kinesics and Context; Broadbent, Perception and Communication; Carroll, Language and Thought.

[3]See, for example, Smith, Communication and Culture.

What is the role in interpersonal interactions of the struture of the medium through which the interactions take place? What is the role in interpersonal interactions of the context in which they occur? What are the variables in the context of interpersonal interactions that make a difference to the interaction? What is the role of past experience in interpersonal interactions? What is the role of future expectations in interpersonal interactions?

3.8 Media ecology takes as its subject matter the interactions between individuals and groups.[1]

What are the effects of the structure of a group on the intrapersonal and interpersonal behaviors of its members? What are the characteristics of a group that constitute its structure? To what extent does individual behavior affect the structure of a group? To what extent does interpersonal behavior affect the structure and functions of a group? How does the structure of a group affect the functions of the individual in the group as a whole? How does the structure of a group affect the functions of the group as a whole?

3.9 Media ecology takes as its subject matter the interactions between groups and cultures.[2]

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[1]See, for example, Smith, Communication and Culture; Duncan, Communication and Social Order.

[2]See, for example, Smith, Communication and Culture; Duncan, Communication and Social Order.

What are the effects on the structure of groups of cultural needs, norms, and values? What are the effects on cultural needs, norms, and values, of the structure of sub-groups in the culture? What functions do groups of different structures serve in the culture at large? What are the consequences of disparate rates of change in the needs, norms, and values of a culture and the structure of its sub-groups?

3.10 Media ecology takes as its subject matter the interactions between technology and "reality."[1]

How do the structures of different technologies organize reality? What are the structural characteristics of different technologies? How can the accuracy or utility of a technology's "reality representation" be judged?

3.11 Media ecology takes as its subject matter the interactions between one technology and another.[2]

What are the effects on existing technologies of the introduction of new technologies that serve similar purposes? What are the effects on existing technologies of the introduction of technologies that serve new functions? What are the effects of imposing a technology with one structure on a technology with a different structure?

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[1]See, for example, Carpenter and McLuhan, Explorations in Communication; McLuhan, Understanding Media; Ellul, The Technological Society.

[2]See, for example, McLuhan, Understanding Media; Boulding, The Meaning of the 20th Century; Innis, The Bias of Communication.

3.12 Media ecology takes as its subject matter the interactions between technology and culture.[1]

What functions in a culture does the structure of a technology allow it to serve? What are the effects of different technologies on cultural perceptions, norms, needs, values? What are the effects of cultural needs, values, norms, and perceptions on the development of new technologies? What are the effects of different technologies on the economic and social structures of a culture? What are the effects of different technologies on the physical environment of a culture? What are the effects of different technologies on the structure and function of existing social institutions (e.g., government, business, law, schools, and so on)?

The presuppositions and goals, principles and hypotheses, subject matter and questions outlined above constitute, in sum, a way of looking at the world that might be called the "media ecological perspective." Like the "systems perspective," the media ecological perspective suggests certain criteria for evaluating representations of reality--in particular, those representations that purport to illustrate the systems, processes, and effects of human communicatiom. These criteria may be summarized in

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[1]See, for example, Boulding, The Meaning of the 20th Century; Ellul, The Technological Society; the Harvard Program on Technology and Society, A Final Review; Innis, The Bias of Communication; McLuhan, Understanding Media; Mead, Cultural Patterns and Technical Change; Mumford, Technics and Human Development.

the form of a list of questions which can be applied to any communication model in an effort to identify its strengths and weaknesses, from the perspectives of media ecologists. Such a list is presented below. For the sake of convenience, the questions are organized in two categories--questions about the scope of the model and questions about its comprehensiveness--and each question is keyed to the item in the outline of media ecology from which it derives.

Media Ecology Guidelines for the Review and Evaluation of Models

1.0 Scope of the Model

1.1 Does the model make reference to the interactions between the structure of a medium, technique, or technology, and its content? (3.1)

1.2 Does the model make reference to the interactions between the structure of a medium, technique, or technology, and its functions? (3.2)

1.3 Does the model make reference to the processes of perceiving, coding, meaning-making, valuing, and change? (3.3)

1.4 Does the model make reference to the interactions between an individual and "reality"? (3.4)

1.5 Does the model make reference to the interactions between coding systems and "reality"? (3.5)

1.6 Does the model make reference to the interactions between human behavior and coding systems? (3.6)

1.7 Does the model make reference to the interactions between one individual and another? (3.7)

1.8 Does the model make reference to the interactions between individuals and groups? (3.8)

1.9 Does the model make reference to the interactions between groups and cultures? (3.9)

1.10 Does the model make reference to the interactions between technology and "reality"? (3.10)

1.11 Does the model make reference to the interactions between one technology and another? (3.11)

1.12 Does the model make reference to the interactions between technology and culture? (3.12)

2.0 Comprehensiveness of the Model

2.1 Does the model reflect the principle that the structure of a communications medium is a message which reveals a certain perception of reality? (2.1)

2.2 Does the model reflect the principle that the structure of a communications medium determines the kinds of messages it can carry? (2.2)

2.3 Does the model reflect the principle that every medium of communication affects every other medium? (2.3)

2.4 Does the model reflect the principle that every medium of communication affects the psychology of the individual and the groups using the medium? (2.4)

2.5 Does the model reflect the principle that different media of communication have different effects on the organization of societies and their institutions? (2.5)

The questions listed above, along with the questions derived from the principles of the systems perspective, were used as general guidelines in the review of the communication models selected for the study (see Chapters 6 and 7), as well as in the formulation of the integrated models proposed at the conclusion of the review (see Chapter 8).

CHAPTER 6

THE SELECTION OF MODELS

It was proposed that the corpus of communication models to be studied in this investigation be selected from those developed in the fields of mathematics (information theory and cybernetics), sociology, anthropology, linguistics, psychology, semantics, and philosophy. The investigator limited the universe of models to be considered for selection in the following way:

1. To insure manageability of the study, the investigator set at fifteen the upper limit on the number of models selected.

2. The models considered for possible selection were confined to those described in works published between January 1945 and January 1973. While the date most frequently cited in communication research as the beginning of the modern communication revolution is 1949, when Claude Shannon and Warren Weaver published The Mathematical Theory of Communication,[1] the founding works in media ecology and general systems theory were published in 1945.[2] The latter date was chosen as the lower limit of the study, therefore, because it is most representative of the birth of the three

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[1]Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communication (Urbana, Ill.: University of Illinois Press, 1949).

[2]See supra, n. 1 , p. 9.

disciplines--communication theory, media ecology, and general systems theory--which are the focus of the present investigation. The date 1973 was chosen as the upper limit of the study to insure that the most current models of communication would be considered for selection.

3. The models considered for selection were confined to those explicitly proposed as models by their designers.

4. To insure manageability of the data, the models considered for selection were confined to diagrammatic, pictorial, symbolic, or verbal models of the communcation process either less than ten typed pages in length in the original or available in a summarized form less than ten typed pages in length in a secondary source. Complex mathematical models and three-dimensional models which cannot be represented in two-dimensional form were not included in the universe of models considered for selection.

5. Because the purpose of the present investigation was to formulate integrated models suitable for the use of media ecologists, and because media ecology is a field of interdisciplinary generalization, rather than of disciplinary specialization, the models considered for selection were confined to those having demonstrated application, by non-specialists, to aspects of communication outside the field in which they were designed.

To insure that the models selected were those having the widest interdisciplinary application, as well as significance within their fields of origin, the investigator used the following selection procedure. On the assumption that introductory college courses in any discipline would make reference to those theories and models having significance and reputability in that field, the investigator used as the criterion for the intradisciplinary reputability of a communication model its mention in the literature cited on the "required and recommended reading" lists of introductory college courses in the contributing disciplines (i.e., linguistics, or semantics, or psychology, and so on). As the criterion for the interdisciplinary relevance of a communication model, the investigator used its mention in the literature cited on the "required and recommended reading" lists of introductory college courses in such generally interdisciplinary fields as studies in human relations, in interpersonal communication, in oral communication, in mass communication, and in communication and culture.

To compensate for the possibility that any single set of reading lists might reflect the philosophical or methodological bias of a particular teacher, school, or region, the intradisciplinary and interdisciplinary reading lists were solicited, by letters addressed to the chairmen of departments in each contributing discipline and interdisciplinary field, from six universities across the country: New York University, Indiana University, Southern Illinois University, Stanford University, University of Michigan, and City University of New York, Queens College.[1] To provide for the event that some major communication models might be "covered" in introductory courses but not represented in the required and recommended readings, the request for the reading lists was accompanied in each case by a request that the instructor providing the lists also

[1]Selected on the basis of the descriptions of their undergraduate and graduate course offerings in the relevant disciplines, as provided in The College Handbook (Princeton: College Entrance Examination Board, 1972), The Annual Guides to Graduate Study (Princeton: Peterson's Guides, Inc., 1972), and current college catalogues.

identify any model or theory he made reference to in his course, but which was not represented in the readings.

The investigator sent out, all told, ninety-six requests for reading lists from the intradisciplinary and interdisciplinary fields, and seventy-four usable returns were received. The breakdown of requests sent and usable returns received, by field, was as follows:

Field	Requests Sent	Usable Returns
Mathematics (Information Theory and Cybernetics)	8	4
Sociology	12	11
Anthropology	12	10
Psychology	14	11
Linguistics	12	10
Semantics	12	10
Philosophy	10	4
Interdisciplinary	16	14
TOTAL	96	74

On receipt of the reading lists from the interdisciplinary fields, the investigator reviewed as a body the literature cited and compiled a list of the most frequently mentioned models. The original intent was to follow the same procedure with the reading lists from each of the contributing disciplines. This proved impossible to do within the time constraints imposed by the context of the study, however, since the total number of works listed on the intradisciplinary reading lists exceeded 1000. The following alternative procedure was employed, therefore, to insure that the models selected had both interdisciplinary relevance and intradisciplinary reputability: For every model cited in the interdisciplinary listing, a search was made to determine whether the work of its author appeared as a primary listing on at least two of the reading lists from the intradisciplinary fields. If a model referred to in the interdisciplinary literature did not appear as a primary listing in the intradisciplinary bibliographies, or appeared only once, it was eliminated from consideration. This procedure left the investigator with twenty-one communication models, each of which satisfied the criteria for interdisciplinary relevance and intradisciplinary significance. These models, identified by their authors were as follows:

Field	Model (Author)
Mathematics (Information Theory and Cybernetics)	Claude Shannon - Warren Weaver
	Norbert Wiener
Sociology	Erving Goffman
	Jurgen Ruesch - Gregory Bateson
Anthropology	Edward Hall
	Dorothy Lee
	Benjamin Lee Whorf
	Edward Sapir
Psychology	Eric Berne
	Thomas Harris
	Adelbert Ames
	Hadley Cantril

Field	Model (Author)
Linguistics	Charles C. Fries
	H. A. Gleason
	G. L. Trager - H. L. Smith
	Noam Chomsky
Semantics	Alfred Korzybski
	S. I. Hayakawa
	Wendell Johnson
	Stuart Chase
Philosophy	Charles Morris

To further reduce the number of models selected, without artificially limiting the depth or scope of the study, the investigator took advantage of the fact that, in several instances, models listed above as separate entries are treated in the interdisciplinary literature as generalized models reflecting the contributions of several different authors. Specifically, the Shannon-Weaver and Wiener models are usually treated as a generalized cybernetic model, the Hall, Lee, Whorf, and Sapir models as a generalized anthropological model, the Berne and Harris models as a generalized transactional model, the Ames and Cantril models as a generalized perceptual model, the Fries, Gleason, and Trager-Smith models as a generalized linguistic model, the Korzybski, Hayakawa, Johnson, and Chase models as a generalized semantic model. In the interest of achieving maximum scope within the limits of the study, therefore, and to avoid the distortion which would have resulted if the work of a single author were chosen to represent the model as a whole, the investigator treated the Shannon-Weaver-Wiener models as a single cybernetic model, the Hall-Lee-

Whorf-Sapir models as a single anthropological model, the Berne-Harris models as a single transactional model, the Ames-Cantril models as a single perceptual model, the Fries-Gleason-Trager-Smith models as a single linguistic model, and the Korzybski-Hayakawa-Johnson-Chase models as a single semantic model. This procedure reduced from twenty-one to ten the number of models selected.

One further modification in the selection procedure was made to insure that the study would be adequate in scope and realistically reflect the most significant contributions to the study of communication. While most of the early work in the field of communication theory was done by scholars identified with specialized disciplines (i.e., psychologists, sociologists, anthropologists, and so on), the field of communication studies has in recent years begun to emerge as a discipline in its own right, and several of the models which appear most frequently in the interdisciplinary literature are drawn, not from one of the specialized disciplines originally identified as the contributing fields, but from the field of communication itself. Therefore, the two most frequently referred to models of this type--the David Berlo and Westley-MacLean models--were included in the corpus of models selected, even though they did not appear on the intra-disciplinary reading lists.

The original selection procedure, with the two modifications described above, left the investigator with twelve communication models for analysis and possible synthesis. These were as follows:

Field	Model (Author)
Mathematics (Information Theory and Cybernetics)	Shannon-Weaver-Wiener
Sociology	Goffman
	Ruesch-Bateson
Anthropology	Hall-Lee-Whorf-Sapir
Psychology	Berne-Harris
	Ames-Cantril
Linguistics	Fries-Gleason-Trager-Smith
	Chomsky
Semantics	Korzybski-Hayakawa-Johnson-Chase
Philosophy	Morris
Communication	Berlo
	Westley-MacLean

Each of the models listed above was reviewed from the perspective of media ecology and systems science, with the aid of the guidelines presented in Chapters 4 and 5. The results of those reviews are presented in Chapter 7.

CHAPTER 7

REVIEW AND EVALUATION OF MODELS

The purpose of this chapter is to provide the reader with a summary of each of the twelve models reviewed in this investigation, and to indicate the strengths and weaknesses of each from both a systems perspective and the perspective of media ecology. To achieve some logical organization and to highlight as much as possible the relationships among the models, the investigator has ordered the summaries according to the level of generalization of the communication model presented (from the most general to the most specific), and has grouped together, within each level, models drawn from a common discipline. Thus, the models are presented in the following order: the general communication models (Shannon, Weaver, and Wiener; Berlo; Westley and MacLean), the sociological models (Ruesch and Bateson; Goffman), the anthropological model (Sapir, Whorf, *et al.*), the general semantics model (Korzbyski, Hayakawa, *et al.*), the linguistics models (Bloomfield, Fries, *et al.*; Chomsky), the philosophical model (Morris), and finally, the psychological models (Ames and Cantril; Berne and Harris).

The Cybernetic Model: Shannon, Weaver, and Wiener

The generalized model of the communication process which is called here, for want of a better term, the cybernetic model, is the product of the efforts of several mathematicians and engineers, primary among them

Claude Shannon, Warren Weaver, and Norbert Wiener. Wiener's work, based on the application of statistical mechanics (developed by the 19th-century Austrian physicist Ludwig Boltzmann) and the Second Law of Thermodynamics (the law which defines entropy, developed by Willard Gibbs) to the problem of control in engineering, was first published in 1948, in the book Cybernetics.[1] (While Wiener is often credited with coining the term "cybernetics," derived from the Greek word kubernetes, or "steersman," it had in fact been used earlier by Ampere with reference to political science, as Wiener himself points out in the revision of his original book, The Human Use of Human Beings.)[2] Shannon and Weaver's work, based on the application of the same concepts (statistical mechanics and entropy) to problems in the electronic transmission of messages (Shannon worked as a mathematical engineer at the Bell Telephone Laboratories), was published in 1949 under the title The Mathematical Theory of Communication.[3]

While Wiener did not, himself provide a graphic representation of the cybernetic model, interpreters of his work--notably W. R. Ashby[4]--have.

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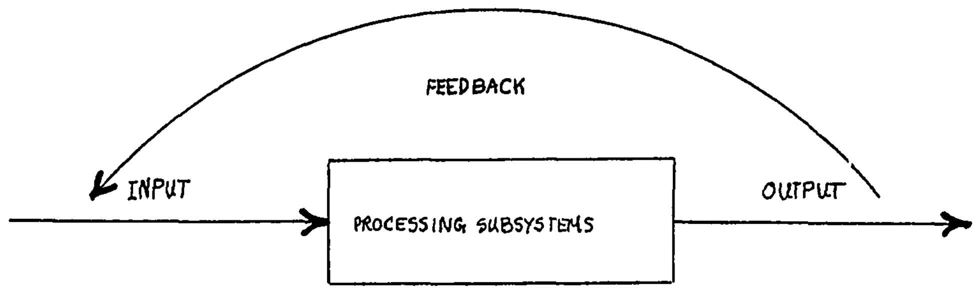
[1]Norbert Wiener, Cybernetics (New York: John Wiley & Sons, 1948).

[2]Norbert Wiener, The Human Use of Human Beings: Cybernetics and Society (New York: Avon Books, 1967), pp. 23-24.

[3]Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communication (Urbana, Ill.: University of Illinois Press, 1949).

[4]W. R. Ashby, An Introduction to Cybernetics (New York: John Wiley & Sons, 1956).

The classic conceptualization of cybernetic theory, the so-called "black box" model, is represented in Figure 1.



The Cybernetic "Black Box" Model[1]

Figure 1

In its most abstract form, then, the cybernetic model defines communication as a process in which some kind of input (incoming data in the form of sensory stimuli, or codes, or energies, or "forces"--depending on the nature of the system) are processed through some set of mechanisms or subsystems and transformed into output (the outcomes or products of the system, which may be different stimuli, or behaviors, or codes, or energies, or "forces"--again depending on the nature of the system), some of which are channeled back into the system (feedback) as new input which affects future system activity.[2]

Shannon and Weaver's model is somewhat similar in its general structure to the "black box" model, but illustrates in greater detail what the major processing subsystems within the black box are. Their conceptualization

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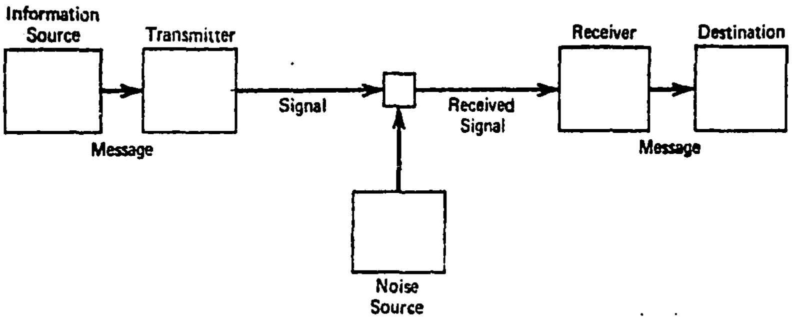
[1]Derived from Ashby, An Introduction to Cybernetics, pp. 86-117, and cited by Glenn L. Immegart, "Systems Theory and Taxonomic Inquiry," in Developing Taxonomies of Organizational Behavior in Education Administration, edited by Daniel E. Griffiths (Chicago: Rand McNally & Company, 1969), p. 171.

[2]Wiener, The Human Use of Human Beings, pp. 34-36.

of the communication process is represented in Figure 2.



The Shannon-Weaver Model of Communication[1]

Figure 2

In its verbal form, the Shannon-Weaver model states that communication is a process in which

> The information source selects a desired message out of a set of desired messages. . . .
> The transmitter changes this message into the signal which is actually sent out over the communication channel from the transmitter to the receiver. . . .
> The receiver is a sort of inverse transmitter, changing the transmitted signal back into a message, and handing this message on to the destination. . . .
> In the process of being transmitted, it is unfortunately characteristic that certain things are added to the signal which were not intended by the information source. These unwanted additions may be distortions of sound (in telephony, for example), or static (in radio), or distortions in the shape or shading of a picture (television), or errors in transmission (telegraphy or fascimile). All these changes in the signal may be called noise.[2]

The major differences in the Shannon-Weaver and Wiener models, as originally designed, are that 1) Wiener did not specify the processing sub-systems (transmitter and receiver) or the specific input-output transforms (signal sent-signal received) of the communication process,

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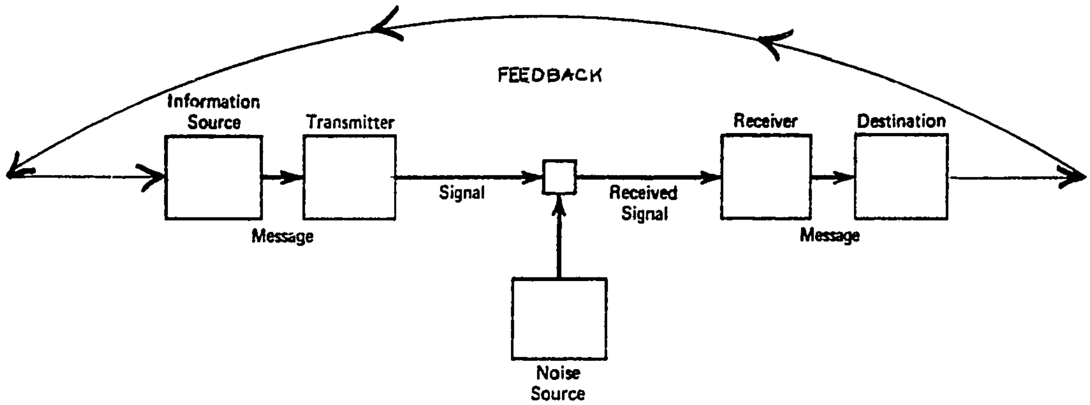
[1]Shannon and Weaver, The Mathematical Theory, p. 98.

[2]Ibid., pp. 98-99.

while Shannon and Weaver did, and 2) Shannon and Weaver did not include the feedback process in their model, while Wiener did. In the generalized form of the cybernetic model, however, the significant contributions of Shannon, Weaver and Wiener are combined, and the model is conventionally represented as in Figure 3.



The Generalized Cybernetic Model

Figure 3

In beginning the explication and evaluation of the generalized cybernetic model, it is important to bear in mind Warren Weaver's point that in communication, "there seem to be problems at three levels: 1) technical, 2) semantic, and 3) influential."[1] The technical problems, according to Weaver, "are concerned with the accuracy of transference of information from sender to receiver. They are inherent in all forms of communication."[2] Semantic problems are not concerned with the transmission of information, but with "the interpretation of meaning by the receiver, as

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[1]Warren Weaver, "The Mathematics of Communication," Scientific American, CLXXI (1949), reprinted in Communication and Culture, ed. by Alfred G. Smith (New York: Holt, Rinehart and Winston, Inc., 1966), p. 15.

[2]Ibid.

compared with the intended meaning of the sender."[1] And influential (or effectiveness) problems are concerned with "the success with which the meaning conveyed to the receiver leads to the desired conduct on his part."[2]

Whether or not one agrees with the "levels" Weaver describes, or with their definitions, these distinctions--especially, the distinction between information and meaning--must be observed in interpreting the cybernetic model, because in its most concrete (mathematical) form, the model deals only with the "technical" level of the communication process--that is, with the transmission of information.

In the mathematical theory of communication, information is defined generally as the measure of freedom of choice the sender has in selecting a message.[3] The greater the freedom of choice available to the sender in selecting a particular message, the greater the measure of information is. Conversely, the higher the probability that some particular message will be selected (i.e., the less "freedom of choice" the sender has), the lower the measure of information contained in the communication. Mathematically, then, information is a measure of the entropy--the degree of randomness or "shuffledness," in Weaver's term--in the source; and the information source is defined by its statistical characteristics.[4]

The capacity of a channel of communication is described, in the mathematical theory, in terms of the amount of information (C) it can transmit from a source of information H, or as the ratio of C (the statistical

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[1]Ibid.

[2]Ibid., p. 16.

[3]Ibid., p. 17.

[4]Ibid., pp. 18-19.

characteristics of the signal) to H (the statistical characteristics of the information sources). The capacity of the channel, so defined, depends on the characteristics of the code into which the transmitter converts the original message. The greater the correspondence between the statistical characteristics of the code and the statistical characteristics of the information source, the closer the ratio C/H approaches unity in a noiseless channel.[1]

In every technical communication, however, noise is introduced into the channel along with the signal. Noise is any signal added by the transmitter, or from any source outside the system, to the original signal in which the message is coded. It increases the uncertainty of the message but, unlike information, noise uncertainty is undesirable uncertainty. In defining the capacity of a noisy channel mathematically, therefore, the amount of equivocation (noise uncertainty) is subtracted from the total uncertainty, and the channel capacity is defined as the maximum rate at which useful information (total uncertainty minus noise uncertainty) can be transmitted over the channel.[2]

Noise can be reduced in a communication by the proper choice of codes, but it is never entirely eliminated. There is, however, a characteristic of information sources which helps to overcome residual noise: redundancy. Redundancy is defined mathematically as unity minus the relative entropy of the information source, in which relative entropy is the ratio of the maximum entropy of the source to its actual entropy.[3]

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[1] Ibid., p. 19.

[2] Ibid., p. 20.

[3] Ibid., p. 21.

The maximum freedom of choice a sender has in selecting messages in English, for example, is theoretically limited only by the possible number of units (words) available and the possible number of combinations that can be produced by random selection. In the actual use of English, however, the choices of messages are limited to a certain extent by the statistical properties of the language. Thus, given that one has already selected the words "in the event," for example, his freedom to choose the next word is quite restricted. In this case, in fact, the probability that the next selection will be "that" is extraordinarily high--as compared to the choice, say, "hippopotamus." In general, the relative entropy of messages in English is about 50%--meaning that English-speaking sources are about half as free as they might possibly (i.e., randomly) be with the symbols available to them. Since redundancy is mathematically defined as unity (100%) minus relative entropy (50%), this means that English is about 50% redundant. As Weaver points out, this fact suggests that, provided one transmitted over a noiseless channel, it would be possible, by proper coding, to transmit messages from English information sources in half the time it takes in ordinary telegraphy. "When there is noise on a channel, however," he adds, "there is some real advantage in not using a coding process that eliminates all the redundancy. For the remaining redundancy helps combat the noise. It is the high redundancy of English, for example, that makes it easy to correct errors in spelling that have arisen during transmission."[1]

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[1] _Ibid._

As a formal, mathematical model, the cybernetic model has had extremely successful application in a variety of fields--predominantly, in telephony, telegraphy, radiography, cryptography, and in those fields concerned with the design of self-monitoring devices and servo-mechanisms such as computers. But in its mathematical form, the model has little or no application to the process of human communication as it is usually conceived. The cybernetic model, it must be stressed, is about <u>information</u> as a mathematically defined phenomenon having no correspondence--or at least no positive correspondence--with meaning or affect. As Weaver points out, from the point of view of the cybernetic model, two messages--one heavily loaded with meaning and one pure nonsense--can be regarded as equivalent with regard to information.[1] In fact, it is more often the case that, according to cybernetic theory, the "nonsense" message contains <u>more</u> information than the "meaningful" one. The message "oxymoron glacial the go," for example, is characterized by greater randomness, greater freedom of choice on the part of the sender, than is the message "please pass the salt"; the former, therefore, carries by definition more information than the latter. This fact has led some writers to suggest that information and meaning may be complementary, in much the same way as the position and velocity of an electron are complementary. The closer you get to one, the farther away you get from the other.

If the cybernetic model does not apply in its mathematical form to human communication, then in what ways does it apply at all? Most often, it is used simply as a conceptual model whose purpose is to provide a con-

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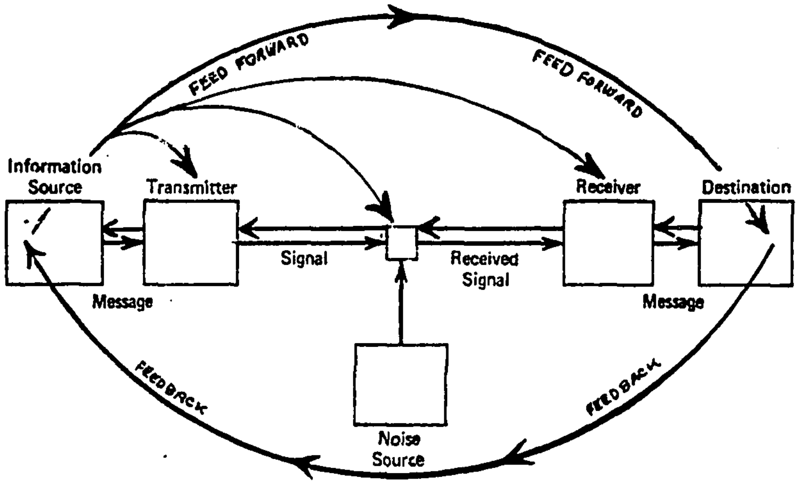
[1] <u>Ibid</u>., p. 17.

venient framework for categorizing the component parts in any communication process and for specifying some of the relationships among them. As such a framework, it has been used not only to analyze and describe specific communication systems in some detail (e.g., classrooms, or churches, or political addresses, or advertising campaigns), but to indicate significant similarities and differences among various communication systems. The model serves a particularly valuable function in identifying possible sources of breakdowns in the communication process (e.g., problems in the source, problems in the code, problems in the transmitter, noise in the channel, and so on), and is even useful for suggesting corrective measures when messages just don't get through (e.g., increase the redundancy of the code, narrow the channel to reduce noise, add more feedback channels, and so on).

As a conceptual model of human communication, however, the cybernetic model suffers from serveral serious defects--from both a systems perspective and a media ecology point of view. The first is that, in its form, the model suggests a one-way, linear sequence of processes in which, for example, the code, the transmitter, the channel, the receiver, and the destination have no effect on the selection of the original message. The feedback loop does suggest that the outcome of the communication does have some modifying influence on the next message through the system, but fails to account for what might be called feed forward--effects on the selection of the original message of preconceived or anticipated outcomes. This defect might be remedied by the addition to the cybernetic model of a series of feed forward arrows, as, for example, in Figure 4.



Cybernetic Model Modified for "Feed Forward"

Figure 4

This modification allows, in the investigator's opinion, a more accurate perception of what systems theorists might call the effects of the internal environment on the functioning of the system. It does not remedy, however, a second major deficiency in the original model: the absence of any reference to the role of the external environment (or suprasystem) in affecting the communication. Clearly, both the formulation of messages and their interpretation are influenced by variables not only in the code, transmitter, channel, receiver, and their interactions, but in the physical, psychological, social, historical, and symbolic environments, as well. The messages I choose to communicate at a defense of this dissertation, for example, are to a large extent determined by the parameters of the physical environment, which affect my choice of medium, which affects my choice of codes, which affects what I can say, and so on. My selection of messages is also affected by my psychological set (for example, needs, values, perceived role in relation to others present), the social context (the rules governing the form, content, and style of interactions in a group constituted for the purpose of evaluating the qualifications of a degree candidate), the historical context (what I know of similar events in the past, my past relations with others present in the room), and other symbolic environments (the written work which the members of the committee have before them). And the meanings which the receivers of my messages will make are similarly affected.

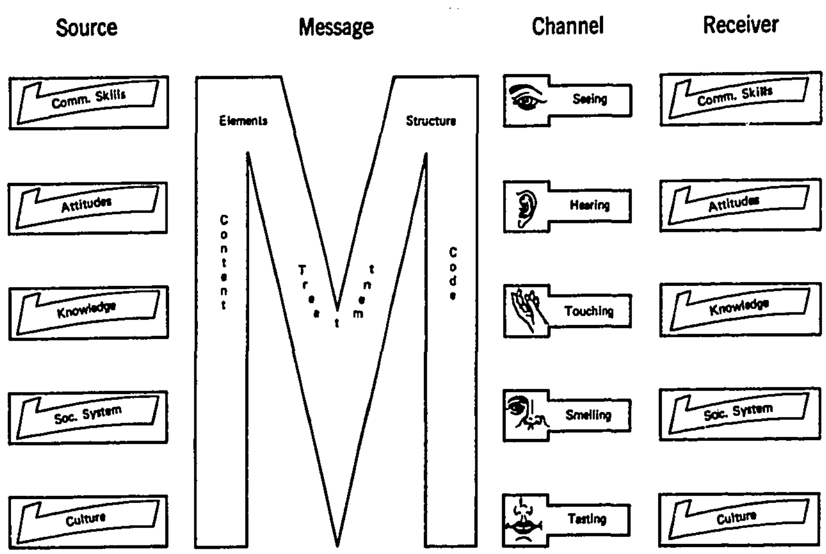
The cybernetic model needs to be modified in form, then, to indicate the relationships between the message-formulating, transmitting, receiving, and interpreting system and the larger systems of which it is a part.

Finally, the model needs to be modified to provide a more detailed framework for describing communication processes. In systems terms, this means specifiying more of the subsystems which make up each of the major components of the system. What are the subsystems that give a code its properties, for example, and what are the effects on sender, message, and destination of variables in the code? What are the subsystems that define the structure of the channel, and how do variables in the structure of the channel affect the messages it can carry?

It is a point worth noting that, even in discussing the limitations of the cybernetic model, the language used is the language Shannon, Weaver, and Wiener have supplied. And therein lies the major contribution of the cybernetic model to the study of communication systems: in the concepts of input, sender, message, code, transmitter, channel, receiver, destination, output, feedback, and noise, it provides not only a lexicon for talking about communication, but also the broadest outline of a taxonomy of communication elements and processes available to date. In that respect, the Shannon-Weaver-Wiener model can serve media ecologists--as it has already served psychologists, sociologists, and students of mass communications (see for example the work of Berlo, Westley and MacLean, and Ruesch and Bateson, described in the following pages)--as an invaluable took for use in constructing broader and more integrated conceptual models of the communication process.

The Berlo Model

One of the most widely used general models of communication in interdisciplinary studies is David Berlo's adaptation of the cybernetic model to human communication processes. Unlike Shannon, Weaver and Wiener, Berlo takes as his primary concerns 1) interpersonal communication, 2) problems of effect, and 3) the variables in the "ingredients" of communication that make a significant difference in what he calls the "fidelity" of communications. Berlo's model, as it appears in The Process of Communication, is represented in Figure 5.



Berlo: The "Ingredients" of Communication[1]

Figure 5

[1]David K. Berlo, The Process of Communication: An Introduction to Theory and Practice (New York: Holt, Rinehart and Winston, 1960), p. 72.

In Berlo's model, the _source_ is defined as "some person or group of persons with . . . ideas, needs, intentions, information, and a purpose for communicating." The _encoder_ (not represented in the diagrammatic model but treated in the verbal model as a function of the source) "is responsible for taking the ideas of the source and putting them in a code, expressing the source's purpose in the form of a message." (As examples of encoders in interpersonal communication, Berlo cites motor skills, vocal mechanisms, and muscle systems in the hand, face and body.) The _message_ is "behavior available in physical form--the translation of ideas, purposes, and intentions into a code, a systematic set of symbols." The _channel_ is, variously, the mode of encoding and decoding messages (e.g., the sense through which the message is perceived), the "message-vehicle" (e.g., television, radio, newspaper), or the "vehicle-carrier" (e.g., light waves, sound waves). The _decoder_ (not represented in the diagram but treated in the verbal model as a function of the receiver) serves to "retranslate, to decode the message and put it into a form that the receiver can use." And the _receiver_ is "the person or persons at the other end . . . the target of communications."[1]

In each of these "ingredients" of a communication, Berlo identifies what he calls "determinants of effect"--variables which increase or reduce the fidelity of the process. ("Fidelity" is defined as the effectiveness with which the source accomplishes his purposes in communicating.)[2]

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[1]_Ibid._, pp. 30-31.

[2]_Ibid._, p. 40.

The determinants of effect within the source-encoder, as indicated in the diagram in Figure 5, are the communication skills of the source (including the symbol systems available to him and his ability to use those symbol systems), his attitudes (toward himself, his subject matter, and the receiver), his knowledge (of himself, his subject matter, the coding process, the channels of communication available, the receiver, and the working of the communication process as a whole), and his position within a socio-cultural system (all the groups to which he belongs, all the values and standards he has learned, his own perceptions of his "place in the world," his position in his own social class, his rank, and so on.)[1]

The determinants of effect in the message are the message code, the message content, and the message treatment. Each of these variables has two features: elements and structure. By elements, Berlo means the individual units in a system; by structure, he means their organizing relations.[2] "Means," "relations," "he," "by," "structure," "their," and "organizing," for example, are the elements in the preceding clause; the structure of the clause is the sequence in which those elements appear. (It is worth noting here that, in good systems style, Berlo stresses that a structure in one system--e.g., a sentence--may be an element in a larger system--e.g., a paragraph.)[3] The elements in the message code are symbols (a "vocabulary"), and the structure of the code is the set of procedures for combining the symbols meaningfully (a "syntax"). In music, for

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[1]Ibid., pp. 41-50.

[2]Ibid., p. 54.

[3]Ibid., pp. 56-57.

example, the elements of the message code are notes (sounds with a certain pitch, duration, and frequency); the structure of the code is the patterns in which notes are combined. Thus, different "musics" have different structures--for example, "classical" and "jazz"--but the same elements. The determinants of effect in the message code, then, are the choice of code, the choice of elements, and the choice of structure.[1]

A second variable in the message is message content, defined as "the material in the message that was selected by the source to express his purpose."[2] By Berlo's definition, the message content in the present communication includes the assertions made, the information presented, and the judgments proposed. Each assertion or fact presented is, by itself, an element in the message content, and the way in which the assertions or information is organized is the structure of the message content. Determinants of effect in the message content, then, include the choice of content (subject matter), choice of elements (assertions, inferences, judgments, etc.), and choice of structure (organization of statements from abstract to concrete, for example, or from concrete to abstract).[3]

The final variable in the message is message treatment, defined as "the decisions which the communication source makes in selecting and organizing both codes and content."[4] For example,

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[1]Ibid., pp. 57-59.

[2]Ibid., p. 59.

[3]Ibid.

[4]Ibid., p. 60.

> In preparing copy for a newspaper, the journalist treats his message in many ways, He selects content that he thinks will be interesting to his reader. He selects words from the code that he thinks his readers will understand. He structures his assertions, his information, in a way that he thinks his reader would prefer to read them. Given his code and content choices, he will vary type size to let his reader know that he considers some things to be more important than others. He will put some stories on page 1 and others on page 11. All these decisions are treatment decisions. They are ways in which the source chooses to encode his message by selecting certain elements of code and content and presenting them in one or another treatment, one or another style.[1]

In discussing the channel in the communication process, Berlo points out that, while the choice of channel makes a significant difference in the effect of communication, the specific determinants of effect in the channel are not yet identifiable. As considerations in the selection of channels, however, he lists such factors as 1) what is available, 2) how much money can be spent (if the channel is a medium such as television or radio), 3) what the source's preferences are, 4) which channels are received by most people, 5) which channels have the greatest impact, 6) which channels are most adaptable to the kind of purpose which the source has in mind, and 7) which channels are most adaptable to the content of the message.[2]

Finally, as determinants of effect in the receiver, Berlo identifies the same variables as present in the source: his communciation skills, his attitudes toward himself, the subject matter, and the sender, his knowledge level, and his position in a socio-cultural system.[3]

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[1]*Ibid.*

[2]*Ibid.*, p. 65.

[3]*Ibid.*, pp. 50-54.

In discussing the role of the receiver in the communication process, however, Berlo adds two generalizations that are important to note here. The first is that the single most significant determinant of effect in the communication process is the relationship between the communication skills, attitudes, knowledge level, and socio-cultural position of the source and the communication skills, attitudes, knowledge level, and socio-cultural position of the receiver. If there is a high degree of correspondence between the two sets of variables, or if the source is skillfull enough to adapt his communication to the characteristics of his receiver, the communication will be effective. If there is little correspondence between source and receiver, or inappropriate adaptation of the communication by the source for his receiver, the communication will not be effective.[1]

As Berlo's emphasis on the need for the source to adapt his communication to the receiver suggests, he considers the receiver to be of predominant importance in the communication process. As he puts it,

> . . . the receiver is the most important link in the communication process. . . . When we write, it is the reader who is important. When we speak, it is the listener who is important. The concern with the receiver is the guiding principle for any communication source. . . . The only justification for the existence of a source, for the occurrence of communication, is the receiver, the target at whom everything is aimed.[2]

This rather strongly-worded generalization brings into focus the major assumptions underlying Berlo's model--assumptions which are at the

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[1]Ibid., p. 53.

[2]Ibid., p. 52.

same time a source of strength and a source of weakness in the model. The first and overriding assumption is that human communication is always purposive. It is, moreover, purposive not in a general sense, but consciously and rationally purposive, directed to a specific end--the production of a particular response in a particular receiver. "Good communication," therefore, is that choice of message, code, elements, structure, treatment, transmitter, and channel which produces in the receiver the response the source desires.

Now, as a general proposition, the concept that communication is purposive and can therefore be evaluated in terms of its effect, is a useful insight. It provides a basis for evaluating not only specific instances of human communication (for example, a speech or an advertisement or a resumé) but whole systems of communication as well (for example, such social institutions as schools, prisons, and hospitals). Given a particular purpose in the source and a discrepant response in the receiver, moreover, the Berlo model serves as a useful diagnostic instrument for identifying possible sources of the communication breakdown. If I want the salt from your table to use on my hamburger, for example, and send you the oral message "Please pass the salt," but you make no response, I can review the variables Berlo identifies as determinants of effect and manipulate them until I get the desired response--for example, change the elements or the structure of the code ("Could I please have the salt?"), or choose a different code altogether (send you a written note), or use a different channel (the waitress, perhaps), and so on.

The difficulty with Berlo's model, however, is that in most communications, neither the purpose of the source nor the identity of the receiver is as clear as Berlo's examples suggest. I am only partially aware of the complex of purposes which underlie the present communication, for example, and in some instances, even those purposes of which I am aware are irrational--having to do, for example, with allaying anxiety, or pleasing people who will never even see the "messages" I am in the process of formulating. And, as the last point suggests, there is no single receiver in this communication process, either. Instead, there is a whole complex of audiences, including myself, all of whom have different needs and attitudes and perceptions. Communicating, then, is not, as Berlo implies, a matter simply of combining different "ingredients" to achieve a single conscious purpose with a single identifiable receiver, and to the extent that his model suggests that effective communication can be achieved by following the right "recipe," it is seriously deficient.

A second major assumption underlying Berlo's model is that receivers are almost infinitely manipulable. Given the right communication skills, enough knowledge, the appropriate attitudes, and a socio-cultural position compatible with (or adaptable to) that of the receiver, and given the correct combination of codes, message, and channel, Berlo implies, the accomplishment of almost any purpose of the source in the receiver is inevitable. The difficulty with this conception is that it overlooks the fact that receivers are as purposive as sources, and that there are incompatibilities in human purpose that are not resolvable through communication--no matter how meticulously planned the choice of variables and the conduct of the process may be.

Given the limitations of Berlo's model, however, it is still quite useful to media ecologists--primarily as a tool for organizing observations and focusing questions. It has an advantage over the Shannon-Weaver-Wiener model, from a systems point of view, in that it identifies many more of the subsystems (i.e., the variables in each of the major elements of the communication process) whose interactions effect the characteristics of the whole. The nature of the interactions among subsystems is not specified in the Berlo model (that is, it is not a process model, as the absence of any reference to feedback, for example, indicates), but as a classification system alone it serves an important heuristic function. What are the "structural" characteristics of such channels as television, radio, film, and LP record, for example? Which characteristics are significant variables in a communication system, and what are the effects of manipulating them on other elements in the system? What are the effects of the channels available in a culture on the purposes which sources can conceive? If a culture as a whole may be considered to be a "source," what are its purposes? What are its messages? Who are its receivers? How does it encode and transmit messages? By directing the attention of media ecologists to questions such as these, and providing a more detailed classification system for the "elements" (if not the processes) of human communication than does the Shannon-Weaver-Wiener model, the Berlo model serves media ecology as a useful, if limited, research tool.

The Westley-MacLean Model

The model known as the Westley-MacLean model of communication is named after two students of mass communications, Bruce H. Westley and Malcolm S. MacLean, Jr., who proposed it as a "preliminary orientation to a theoretical system" for communications analysis in 1957.[1] Like the Berlo model, it is an adaptation of the Shannon-Weaver-Wiener model, but, unlike Berlo, Westley and MacLean focus on mass communications and on roles and processes, rather than on elements and structures.

According to Westley and MacLean, every communication system requires a minimum number of roles and processes. They include the following:

A's (Advocacy roles). A's generally correspond to what are usually called the communicators, senders, or sources in a communication system--the persons or social units engaged in selecting and transmitting messages purposively.

B's (Behavioral system roles). B's generally correspond to what are usually called the receivers or, in mass communication, the "public," or the "audience"--a person or social unit requiring and using communications about the conditions of its environment for the satisfaction of its needs and solution of its problems.

C's (Channel roles). C's serve as the agents of B's in selecting and transmitting non-purposively the information B's require, especially when the information is beyond the immediate reach of B.

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[1]Bruce H. Westley and Malcolm S. MacLean, Jr., "A Conceptual Model for Communications Research," Journalism Quarterly, XXXIV (1957), pp. 31-38.

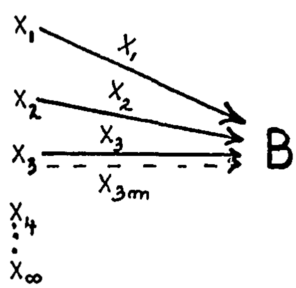
X. The totality of objects and events "out there." X^1 is those objects and events as abstracted into transmissible form: messages about X's and A-X relationships.

Channels. These are the means by which X's are moved by way of A's and/or C's to B's. Channels include "gates" manned by C's who in various ways alter messages.

Encoding. The process by which A's and C's transform X's into X^1's. Decoding is the process by which B's internalize messages.

Feedback. The means by which A's and C's obtain information about the effect of messages on B's.[1]

The diagrammatic model in which Westley and MacLean illustrate the interactions of A's, B's, C's, and X's is quite complex and is usually presented, therefore, in four stages, each representing communication at a different "level," or in a different context--that is, the intrapersonal, interpersonal, and mass communication contexts. The intrapersonal communication process is represented in Figure 6.



Westley and MacLean: The Intrapersonal Process[2]

Figure 6

[1] Ibid., p. 38.

[2] Ibid., p. 32.

In verbal terms, in the intrapersonal process, "objects of orientation ($X_1 \ldots X_\infty$) in the sensory field of the receiver (B) are transmitted directly to him in abstracted form ($X_1 \ldots X_3$) after a process of selection from among all X's, such selection being based at least in part on the needs and problems of B. Some or all are transmitted in more than one sense (X_{3m}, for example)."[1]

To take a simple example: Joe Smith (B) awakes in his home one night and selects from the totality of events, processes, and objects in his sensory field (X) the smell of smoke (X_1), a crackling sound (X_2), and the sensation of heat (X_3). From these, presumably, he abstracts the generalization, fire. (Note that the model in Figure 6 provides no reference to the organization of individual stimuli in a generalization, no reference to feedback attempts on B's part--i.e., checking the generalization against additional stimuli--and no reference to the relationship of perception to behavior. These may be considered weaknesses in the model.) Through some set of processes not specified in the model, in any case, B transforms his perceptions into action. Specifically, he runs next door to his neighbor's house and shouts up at the darkened window, "Bob! Fire! Help!" This engages him (assuming Bob is home) in an interpersonal communication.

According to Westley and MacLean, there are two different types of interpersonal systems. In the first, Person A transmits a message X^1 about object or event X (which may or may not lie in B's sensory field) to Person B, with the intent to influence B. In the interpersonal

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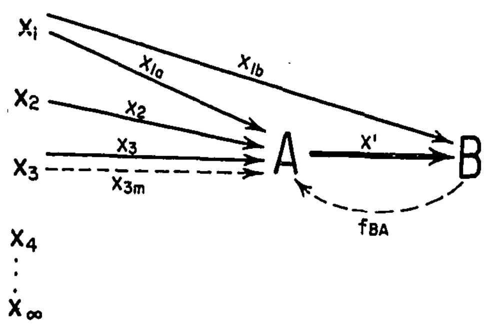
[1]Ibid.

situation, unlike the intrapersonal situation, B is oriented simultaneously toward A (the purposive communicator) and X (the object or event which A's message is about). In the Westley-MacLean model, the face-to-face interpersonal communication with a purposive communicator is represented as in Figure 7.



Westley and MacLean:
The Interpersonal Process, Purposive Communicator[1]

Figure 7

In verbal terms, in the interpersonal process where there is a purposive communicator, "X's are selected and abstracted by the communicator (A) and transmitted as a message (X^1) to B, who may or may not have part or all of the X's in his own sensory field (X_{1b}). Either purposively or non-purposively B transmits feedback (f_{BA}) to A."[2]

To illustrate, let us return to the example given earlier. We left Mr. Smith, you will recall, shouting for help on his neighbor's lawn.

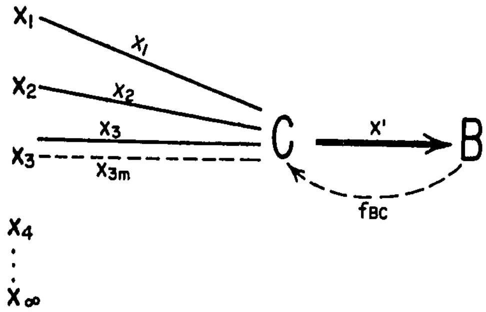
[1] Ibid., p. 33.

[2] Ibid.

In terms of the diagram in Figure 7, Mr. Smith is now A, (the purposive communicator), Bob Jones is B (the audience whom A intends to influence), and the purposive message, "Bob! Fire! Help!" is X^1 on the arrow A--B. Now it so happens that Bob Jones (B) was already awake and, just at the moment he heard Smith's shouts, happened to be looking at what seemed to be smoke coming from his neighbor's house (X_{1b}). When Jones heard Smith's shouts, he turned on the bedroom light to get dressed (thus providing Smith with non-purposive feedback), then called out the window, "I'm coming!" (purposive feedback). The feedback from Jones (B) to Smith (A) is represented on the broken loop f_{BA}.

Note that, while the model in Figure 7 indicates that B is simultaneously oriented toward A (the communicator) and X (the event as he himself experiences it), there is no reference to the process by which B organizes the two perceptions, or, in other words, to the interactions of his perception of A, his perception of A's report of X, and his own perception of X. This is another weakness in the model.

Westley and MacLean distinguish between the interpersonal situation described in Figure 7 (that is, the face-to-face situation in which there is a purposive communicator) and a different situation in which a non-purposive communicator (C) selects and transmits messages to B about X's important to B (i.e., satisfying to B's needs or useful in solving his problems), where those X's lie beyond B's sensory field. In this situation, then, the role of C is simply to extend B's environment. In the Westley-MacLean model, the interpersonal communication with a non-purposive communicator is represented as in Figure 8.



Westley and MacLean:
The Interpersonal Process, Non-Purposive Communicator[1]

Figure 8

In verbal terms, in the interpersonal process where there is a non-purposive communicator, "What X's B receives may be owing to selected abstractions transmitted by a non-purposive encoder (C), acting for B and thus extending B's environment. C's selections are necessarily based in part on feedback (f_{BC}) from B."[2]

To return to our example: Imagine now that Smith's house is located in a small suburb where there is a one-man radio station, and that the owner-manager-producer-director-reporter-announcer for that station, Sam Casey, arrives at Smith's house along with the fire engines. Four hours later, on his 7 o'clock news program, Casey reports to his listeners, among other things, that a fire at Bill Smith's house was put out at 4 a.m.,

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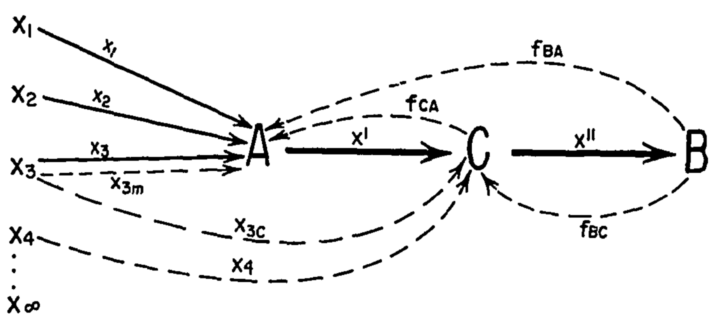
[1]*Ibid.*, p. 34.

[2]*Ibid.*

and no injuries resulted. In terms of Figure 8, Sam Casey is C; his audience is B; his message about the fire is X^1 on the arrow C--B; and his experiences of smoke, flame, heat, and so on are X_1, X_2, X_3, etc. Purposively or non-purposively, B (the audience) provides feedback (f_{BC}) to C (Casey)--purposively, by writing or calling the station; non-purposively, by switching to another station (which Casey presumably learns about eventually through some sort of audience ratings survey).

The mass communication process is different from both the intrapersonal process and the interpersonal processes described on the preceding pages, according to Westley and MacLean, in that mass communication involves the interaction in one system of A's, B's, C's, and X's. The mass communication process, as it is diagrammed in the Westley-MacLean model, is represented in Figure 9.



Westley and MacLean:
The Mass Communication Process[1]

Figure 9

[1] Ibid.

In verbal terms, in mass communication, "The messages C transmits to B (X") represent his selections from both messages to him from A's (X') and C's selections and abstractions from X's in his own sensory field (X_{3c}, X_4), which may or may not be X's in A's field. Feedback not only moves from B to A (f_{BA}) and from B to C (f_{BC}) but also from C to A (f_{CA}). Clearly, in the mass communication situation, a large number of C's receive from a very large number of A's and transmit to a vastly larger number of B's, who simultaneously receive from other C's."[1]

To take our earlier example to its conclusion (in terms of the Westley-MacLean model, that is), imagine now that radio-owner-announcer Casey (the C of Figure 8) sends a report on the Smith fire to the suburban desk of NBC News. In the model in Figure 9, Casey is now A, his message about the fire is X' on the arrow A--C, and NBC News is C. Unknown to Casey, NBC has also received from its own reporters news of two other fires in the same suburban town on the same night (X_{3c} and X_4). On the nine o'clock news that morning, therefore, NBC reports to its listeners (B) that a sudden rash of fires hit suburban Jamestown during the night (message X" on the arrow C--B). By including the Smith fire in its report, NBC provides non-purposive feedback to radio-owner-announcer Casey (f_{CA}), and, by writing or telephoning the station, NBC's viewers (B) provide feedback to C (f_{BC}). In this example, it is unlikely that B (the audience) would also provide feedback to A (radio-

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[1] Ibid.

owner-announcer Casey), but in other mass communication situations (for example, when A is an advertiser), B may provide either direct (letters to the sponsor) or indirect (purchases of the product) feedback to A (f_{BA}).

To summarize, then, the major points which the Westley-MacLean model stresses are 1) that communication processes involve selection; 2) that the selection of messages is performed in part by purposive communicators (A's) with the intent of influencing receivers (B's), and in part by non-purposive agents of B's, or gatekeepers (C's); 3) that the role of any participant in a communication system varies according to the context; 4) that the mass communication process is a three-step interaction (X--A--C--B); and 5) that the interaction is accomplished, guided, and modified through feedback. These insights, along with the fact that the model stresses process, may be regarded as its major strengths.

The model also has serious limitations, however, from both a systems and media ecology point of view. The first is oversimplification. The intrapersonal model (Figure 6), for example, makes no reference to 1) the variables that affect B's perception of X's; 2) the interactions among $X_1, X_2, X_3 \ldots X_\infty$; 3) the effects of the structure of the medium (i.e., the sense through which an X is perceived) on the messages it carries; or 4) feedback from B to X. The interpersonal model (Figure 7), while it represents A (the communicator), B (the receiver), and X (the event) standing in interaction, makes no reference to the effects of B's perception of X on his perception of A and the message A transmits, nor to the effects of his perception of A (e.g., his probable purpose, his authority, his reliability, etc.) on his perception of X or of the message X^1. The model also fails to represent the relationship between the message X^1 and the messages X_{1a}, X_2, X_3, and so on. And finally, while the feedback process is represented in the interpersonal and mass communication models, the effects of feedback are not.

Perhaps the most serious weakness in the Westley-MacLean model, however, is the definition of C (the "gatekeeper") as a non-purposive encoder. In the mass communication model, it must be remembered, C represents (for example) Walter Cronkite. The conception that Cronkite (C) acts merely as a neutral "agent" for the audience (B), and has no intent to influence B's perception of X (say, for example, the Watergate affair) or of an A-X relationship (for example, the President's statements about the Watergate affair), seems to this investigator to be an unwarranted and unnecessary distortion of the mass communication process. Whether a communicator intends to affect B's perception of X (and therefore, whether the communicator should be categorized as an A or a C) is not a question that can be answered by observations of a given communication process. The distinction between A (purposive) and C (non-purposive communicator) is, therefore, not very useful for descriptive purposes.[1] It is, moreover, irrelevant. Whether or not C intends to influence B by screening messages, he (or it, as the case may be) in-

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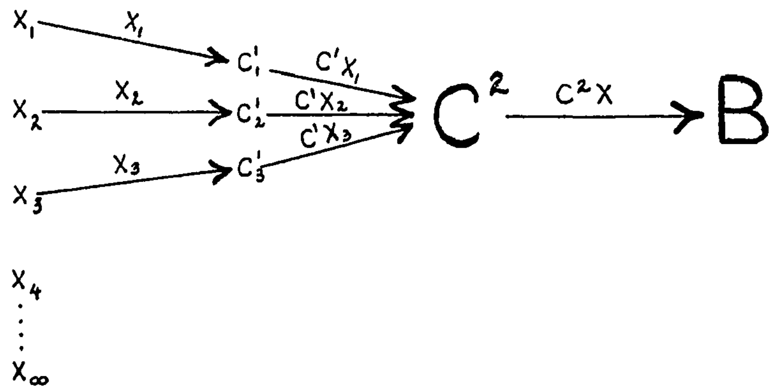
[1]The concept of purpose is, of course, essential to a model whose primary function is to serve as an evaluative tool (Berlo's model, for example), but the Westley-MacLean model is intended primarily to describe.

evitably does, and a descriptive model of communication processes that ignores this point is seriously weakened.

For the reasons given above, the investigator proposes that C be redefined, in the Westley-MacLean model, as any agent or agency in a communication system which serves to receive, screen, and in the screening process, modify, messages for B. With C so redefined (i.e., as any "gatekeeper "), the intrapersonal process can be represented as in Figure 10.

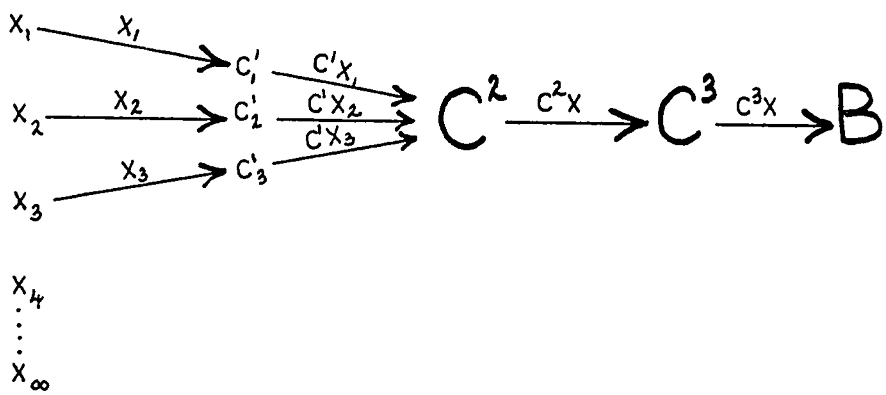


The Westley-MacLean Intrapersonal Model,
Modified for "Gatekeeping"

Figure 10

In words: Events, objects, and processes in "reality" (X_1 . . . X_∞) are received through sensory organs manned by "gatekeepers" (C^1) which screen out certain kinds of information (depending on the neurological structure of the sensory ending) and transform the remainder into a coded message, C^1X (a chemo-electrical impulse), which is passed on to a center manned by another "gatekeeper," C^2 (a precept), which screens out certain of the messages C^1X, adds other messages (information stored in the brain about messages similar to C^1X received in the past), and sends the modified message C^2X (a concept) to B.[1]

To represent an intrapersonal process in which some instrument is interposed between X and B'x sensory gatekeepers (e.g., a telescope, microscope, etc.) would require simply the insertion of another set of C's between X and B, as for example, in Figure 11.



Technologically-Mediated Intrapersonal Process

Figure 11

In Figure 11, X may represent, for example, planets and stars; C^1 is a telescope (and $C^1{}_1$, $C^1{}_2$, $C^1{}_3$ are variab!es in the structure of the instrument--for example, how much light it lets in, how large the field is, what the power of magnification is) which receives, screens, and modifies the information available and transmits it in a new form (C^1X) to the eye of the receiver, C^2; C^2 acts as a second "gatekeeper,"

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[1]The language of "sending" and "receiving" causes some difficulties here, because it implies transmission over space or time, from one distinct "place" to another. Obviously, the brain does not "send," in this sense, messages to the person-as-a-whole represented by B, but, at the same time, the person-as-a-whole needs to be distinguished in some way from a particular concept which he "receives."

screening out certain information and passing on a modified message (C^2X) to the brain, where a third "gatekeeper," C^3 (precept) screens out, adds to, and modifies the information received, then "transmits" a modified message, C^3X (concept), to B.

With C redefined, the intrapersonal, interpersonal, and mass communication situations may all be represented as some variation of an X--C--B or X--C--A--C--B process (A being retained to indicate a communicator with a message about X), in which the major difference between processes lies in the length of the C strings (reflected in the exponential value of C) between X and B. Thus, the message received by B in the "simplest" intrapersonal communication would be a C^2 message (information screened and modified by two sets of gatekeepers), while the message received by B in a mass communication process might be, for example, a C^{36} message.

The proposed redefinition of C, then, serves several purposes: it focuses the attention of the model (or of the model user) on the effects, rather than the purposes, of C in the communication process, remedies certain inconsistencies in the original model (for example, the absence of any reference to a "gatekeeper" in the intrapersonal--X--B--and interpersonal--X--A--B--processes), simplifies the model to some extent, and gives it greater generalizing and heuristic power. Perhaps the most interesting question to which it gives rise is whether a C^{36} message, for example, is more or less reliable than a C^2 message--or better, in what contexts and for what purposes are C^{36} messages more reliable than C^2 messages, and vice-versa.

In any case, while the Westley-MacLean model clearly has its limitations (it is not very detailed, for example, in specifying the subsystems involved in the selecting, coding, transmitting, meaning-making, and feedback processes), it also provides media ecologists with a basic process conception of communication which has exceptionally fruitful heuristic potential.

A Sociological Model: Ruesch and Bateson

If a media ecologist may be defined, as Chapter 5 suggests, as someone who sees communication as the connecting link in the operation of intrapersonal, interpersonal, intragroup, intergroup, socio-cultural, and technocultural systems, and as someone who chooses, therefore, to study all such systems from the perspective of communication processes, then Jurgen Ruesch and Gregory Bateson are media ecologists. Ruesch is by profession, or more accurately, by official title at the U.C.L.A. School of Medicine and the Langley Porter Neuropsychiatric Institute in San Francisco, a social psychiatrist. He is also, by avocation, an anthropologist, a cyberneticist, an information theorist, and a pioneer in the study of non-verbal codes. Gregory Bateson is even more difficult to label in the conventional way than Ruesch. Educated at Cambridge as a zoologist, then as an anthropologist, he has worked and written extensively not only in those two fields, but in cybernetics, psychology, and psychiatry (which credits him with the development of the "double bind" theory of schizophrenia), meta-linguistics, film and art criticism, and animal and cetacean communication. By his own account, Bateson is presently concerned with "four sorts of subject matter: anthropology, psychiatry, biological evolution and genetics, and the new epistemology which comes out of systems theory and ecology."[1]

In 1951, Ruesch and Bateson collaborated in writing Communication: The Social Matrix of Psychiatry.[2] The following excerpt from the Preface to the 1968 edition indicates the context in which the book was written and suggests something of the perspective from which Ruesch and Bateson approach their subject:

> At the time this book was written, it became abundantly clear that the age of the individual had passed. In spite of the temporary flowering of psychoanalysis, the main stream of events was no longer concerned with the private problems of people. The threat of atomic destruction, the mushrooming of the mass population, the horrifying specter of future famine, the progressive pollution of air and water, and the gradual decay of urban centers all pointed to the fact that the old ways of coping with human problems had become ineffective. Psychological man was dead and social man had taken his place. However, no unified or general theory was available at that time that could adequately represent the person, the group, and society all within one system. True, there were theories pertaining to small groups on the one hand and to the societal order on the other; but what was lacking was a connecting link that would enable scientists to connect person to person, person to group, and group to the wider social order.
>
> At this point the theoretical developments in the field of cybernetics and communication engineering were able to bridge the gap. By focusing not upon the person or the group, but upon the message and the circuit as units of study, a way was found to connect various entities. . . . The description of a theory of communication, adapted to the human situation . . . was the end to which this book was written.[3]

Given the background, interests, and perspective of its authors, it is not surprising that the Ruesch and Bateson model of communication

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[1]Gregory Bateson, Steps to an Ecology of Mind (New York: Ballantine Books, Inc., 1972), p. xii.

[2]Jurgen Ruesch and Gregory Bateson, Communication: The Social Matrix of Psychiatry (New York: W. W. Norton & Company, Inc., 1968).

[3]Ibid., pp. vi-vii.

systems is the broadest in scope of all the models reviewed in this investigation. It is presented in three forms in the concluding chapter of Communication: a diagram, a chart, and a verbal statement. In the following summary, the diagram and chart are presented and discussed, and portions of the verbal statement are used to clarify the interpretation of the model.

The Ruesch and Bateson model, in its diagrammatic form, is about two different but related things: the "levels" of communication and the relationship of the observer of communication processes to what he can see and say about them. Looking at communication systems from outside the network, Ruesch and Bateson note, is analogous to looking through a microscope with a variable field: as the area of the field increases, the level of magnification of objects within the field decreases, and, conversely, as the field narrows, the objects in it are seen in greater detail.[1] The diagrammatic model Ruesch and Bateson provide (Figure 12) is intended, in part, to illustrate this point.

In Figure 12, the four cross sections of the cone represent the four different levels of communication systems: Level I, the intrapersonal system; Level II, the interpersonal system; Level III, the group system; and Level IV, the cultural system. The four sectors of the cone, running vertically through all cross sections, represent the four processes or functions common to all communication systems: e: evaluating, s: sending; c: channel; and r: receiving. The placement of the symbols

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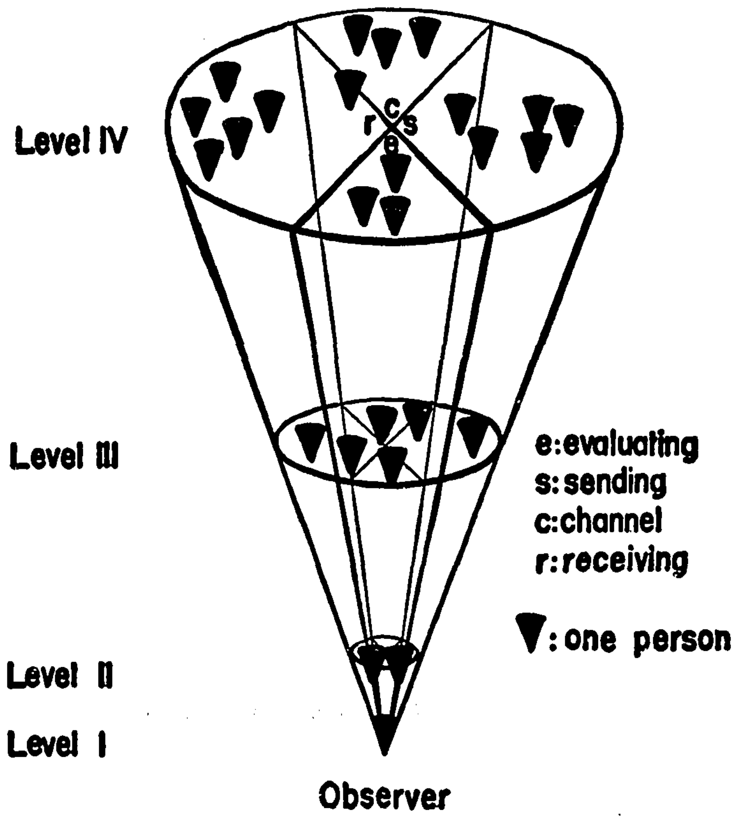
[1] Ibid., pp. 273-274.



Ruesch and Bateson: The "Levels" of Communication[1]

Figure 12

for persons is intended to indicate, in Ruesch and Bateson's words, that

> At the intrapersonal level, the focus of the observer is limited by the self, and the various functions of communication are found within the self. At the interpersonal level, the perceptual field is occupied by two people, at the group level by many people, and at the culturalilevel by many groups. Concomitantly, in each of these fields, the importance of the single individual diminishes, and at the higher levels one person becomes only a small element in the system of communication.[2]

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[1] Ibid., p. 275.

[2] Ibid., p. 274.

In conjunction with Figure 12, Ruesch and Bateson stress four points about the observer-system relationship which are worth noting here: 1) the observer of communication can only have one focus (i.e., observe one level of communication) at any one time; 2) the focus of the observer is not fixed; rather "it has to be viewed as a fluctuating or oscillating phenomenon in which quick glances are taken rapidly at various levels and at various functions"; 3) whenever an observer sets out to study communication systems, he must identify his position as observer (i.e., what level of communication he is looking at); and 4) he must identify his own function within the system he is observing.[1]

The last point above is especially important in the observation of intrapersonal and interpersonal (dyadic) communication systems, since, quite clearly, the presence of the observer changes the level of the system he is observing. A psychiatrist cannot directly observe the intrapersonal system of a patient, for example, because his very presence moves the system to the interpersonal level. The psychiatrist deals directly, then, with the psychiatrist-patient interpersonal system, and tries to infer from that system the characteristics of the patient's intrapersonal communications. Similarly, the presence of an observer changes a dyad (two-person communication system) into a group--a different system altogether--and the observer can only infer the characteristics of the dyadic communication from the characteristics of the communication within the group. This may seem an obvious point, but it is often ignored in the study of communication systems. To take a recent case in

[1]Ibid., pp. 274-276.

point, both the title and much of the commentary on the film study An American Family[1] gave the impression that the series was "about" the Loud family. As Ruesch and Bateson would no doubt point out, however, the subject of the study was a different system altogether, and to reflect that fact the series might more accurately have been titled The Relationship of an American Family to a Camera Crew Living with Them.

Ruesch and Bateson provide a more detailed representation of the levels and functions of communication in a table (Figure 13) in which the cross sections of the cone in Figure 12 are represented along the vertical axis and the sectors of the cone are represented along the horizontal axis.

In addition to the information presented in the table itself (which seems to the investigator to be self-explanatory and not in need of interpretation here), Ruesch and Bateson provide the following definitions and characterizations of communication systems at different levels.

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[1]A series of twelve one-hour "cinema verite" films--abstracted from almost a year's continuous filming of the William Loud family, of Santa Barbara, California--produced by Craig Gilbert and broadcast over the ETS (Educational Television Services) Network in 1973.

LEVELS	ORIGIN OF MESSAGE	SENDER	CHANNELS	RECEIVER	DESTINATION OF MESSAGE
I. Intrapersonal "within one"	Sensory end organ or Communication center.		Neural, humoral pathways and contiguous pathways.	Communication center or the effector organs.	
II. Interpersonal "one to one"	Communication center of person sending message.	Effector organ of sending person.	Sound, light, heat, odor, vibrations traveling across space on the one hand, chemical or mechanical contact with material or person on the other hand.	Sensory end organs of receiving person.	Communication center of person receiving message.
III. A. Group "One to many" (centrifugal messages)	Communication center of group: head man or committee.	Person specializing in being a mouthpiece or executive for the communication center.	Multiplication of message through press, radio, loudspeaker system, movies, circulars, etc.	Persons engaged in receiving and interpreting incoming messages for the group—readers, listeners, theater spectators, critics.	Many persons who are members of a group. Identity of persons is unspecified by name; they are known by role. Group is specified.
B. Group "Many to one" (centripetal messages)	Many persons who are members of a group. Identity of persons is unspecified by name; they are known by role. Group is specified.	Spokesman who expresses the voice of the people, the family, or other small groups at the periphery.	Mail, word of mouth, or other instrumental actions of people.	Professional specialists who engage in receiving messages: news analysts, intelligence service, government agencies. Condensation and abstraction of incoming messages.	Communication center of group—executive, committee, or head man.
IV. A. Cultural "Space binding" messages of "many to many"	Many groups unspecified by name, known by role, which express moral, aesthetic, or religious views—e.g., the clergy, children.	Groups specializing in the formulation of standards of living: legislators.	Script, written and unwritten regulations and laws. Customs transmitted by personal contact often implicit in action. Persons become channel.	Groups engaging in the reception and interpretation of cultural messages such as judges, lawyers, scientists, ministers.	Many groups composed of living people, unspecified by name, known by role.
B. Cultural "Time binding" messages of "many to many"	Many unspecified groups the members of which are older than the receivers or already dead.	The voice of the past, frequently a mythological or historical figure.	Script, material culture such as objects, architectural structures, etc., and personal contact from generation to generation often implicit in action.	Group specializing in the reception and interpretation of the messages of the past—archaeologists, historians, clergy.	Many unspecified groups the members of which are younger than the originators of the message.

Ruesch and Bateson: Specification of Networks
at the Four Levels of Communciation[1]

Figure 13

Intrapersonal communication is, in Ruesch and Bateson's view, a special case of interpersonal communication in which "an imaginary entity made up of condensed past experiences represents within an individual the missing outside person."[2] It is characterized by the facts that

--The self-observer is always totally participant.

--Both the place of origin and the destination of messages are located within the sphere of one organism; and the correction of errors is therefore difficult, if not impossible.

[1]Ruesch and Bateson, Communication, p. 277.

[2]Ibid., p. 15.

--The system of codification used can never be examined.[1] The significance of these facts is that the analysis and modification of intrapersonal communication can only be accomplished through an interpersonal interaction. That is, there must be available to the individual who wants to examine his intrapersonal processes a point of reference outside his own system. The study of intrapersonal communication processes, in short, must be a comparative study.[2]

Within the intrapersonal system, Ruesch and Bateson identify three distinct groups of functions: reception, transmission, and central functions. Reception includes two different processes, proprioception and exteroception:

> Proprioception gives information about the state of the organism; in popular language, these data, if consciously perceived, are referred to as feelings or sensations. In proprioception the end organs are predominantly internal and react to chemical and mechanical stimuli; in exteroception, the end organs are located on or near the surface of the body, and give information about relations between the self and the environment. The exteroceptive end organs react to wave phenomena, such as light and sound, in addition to other mechanical and chemical stimuli.[3]

Similarly, transmission in intrapersonal communication includes propriotransmission and exterotransmission:

> In propriotransmission, nervous impulses travel on the efferent pathways to the smooth muscles, and chemical impulses travel along humoral pathways for purposes of regulation of the organism. In exterotransmission, the contraction of the striped muscles is used for action upon the outside world, including commun-

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[1]Ibid., p. 278.

[2]Ibid., pp. 199-200.

[3]Ibid., p. 278.

ication with other individuals.[1]

The central functions of intrapersonal communication include coordination, interpretation, and storage of information. As Ruesch and Bateson point out, one of the significant tasks accomplished through the central functions is the combination of information received through proprioception or propriotransmission with information received through exteroception or exterotransmission, which, they note, are complementary sets of information:

> The complementary relation between proprioception and exteroception is such that complete information could only be obtained by a combination of these two functions. Such total combination seems, however, to be impossible, and in its functioning the organism seems to specialize at certain moments in one or the other mode of experience, with resulting failure to act upon data which might have been derived from the other mode: pain may preclude external perceptiveness, and exposure to violent external events may preclude awareness of pain or fatigue.[2]

Interpersonal communication, in Ruesch and Bateson's definition, is interaction which includes 1) the presence of expressive acts on the part of one or more persons; 2) the conscious or unconscious perception of such expressive acts by other persons; and 3) the return observation that such expressive actions were perceived by others. (The perception of having been perceived by others--i.e., feedback--is, Ruesch and Bateson point out, a fact which deeply influences and changes human behavior.)[3] Interpersonal communication is further characterized by the facts that

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[1] Ibid., p. 279.

[2] Ibid.

[3] Ibid., p. 15.

--Both the place of origin of messages and the destination of messages is known to the senders and the recipients; therefore, correction of information is possible.

--The person engaged in observation of others must of necessity be partially participating, partially observing. Both participation and observation are parts of experience and therefore means of collecting information. The two types of information so gained complement each other, but the complementation is never complete. At any one moment the individual must specialize in one or the other modes of experience and must therefore fail to collect the information which might have been gathered by the other mode.

From this complementary relation and from the fact that the gathering of complete information is impossible, it follows that the human individual can never perceive himself perfectly in relation to others. There is always a discrepancy between his more proprioceptive view of himself and that knowledge of himself which he gets through his own exteroceptors, or from the observations of others. Similarly he cannot entertain at the same time both a proprioceptive picture of himself and a picture of himself as defined by his status or social situation.[1]

In group communication, Ruesch and Bateson point out, the functions of receiving, transmitting, and coordinating are unequally divided among the persons; that is, special roles in regard to each function are usually assigned in the organized group:

--This restriction or specialization of function is characteristic of all organization and has the effect of re-establishing in some degree the directional flow of messages. It also unites the individuals into a larger unit capable of carrying out the three great functions of reception, transmission, and coordination.

--Typically, in larger organized groups, only the source or only the destination of many messages is distinct and known to the participants; the unknown part is related to the fact that individuals may either act as source and

[1] *Ibid.*, p. 280.

> destination, or as channels which merely relay the message to other individuals. The correction of messages is therefore delayed and frequently is possible only by short-cutting the traditionally established pathways.[1]

In group communication, Ruesch and Bateson note, two types of messages can be distinguished: "one person to many" messages, in which information flows from the center of the group to the periphery, and "many persons to one" messages, in which information flows from the periphery of the group to the coordinating center. In the former instance, reply is often delayed, if it occurs at all, since the "one" person is primarily engaged in transmission, while the "many" are primarily engaged in receiving. In the latter case, the information flow is characterized by the progressive abstraction of messages, required by the limited capacity of the receiver, and the "one" person is more engaged in receiving, while the "many" are engaged primarily in transmission.[2] From the separation of communication functions in the group, and from what has been said of complementarity, Ruesch and Bateson add, it follows that

> . . . the completeness of information obtained by any given individual in an organized group decreases with every increase in complexity and differentiation of the system. In the organized group each individual is assigned specialized functions, either as observer or as transmitter or as coordinator, and this specialization implies impoverished perception. It is conspicuous also that where two groups are in contact, the information upon which the members of each group base their pictures of their own and of the other group is inflexible, stereotyped, and projective.[3]

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[1]*Ibid.*, pp. 280-281.

[2]*Ibid.*, p. 281.

[3]*Ibid.*

In cultural communication, according to Ruesch and Bateson, the individual is for the most part unable to recognize the source and destination of messages. The cultural network is, for that reason, largely an unperceived communication system which carries, however, many of the basic premises of the culture. Cultural communication is further characterized by the facts that

> --Messages are transmitted from many persons to many. The sources and destination of messages are, however, unknown; the potentialities for receiving and transmitting are unascribed; and the correction of information is therefore impossible.[1]
>
> --When participating in a cultural network, people are in many cases unaware of being the receivers or senders of messages. Rather the messages seem to be an unstated description of their way of living. They attribute them to no human origin, but they themselves transmit the message to others by living in accordance with its content, which they regard as "human nature."[2]

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[1]This generalization seems to overlook the fact that, in some cultures, at least, there are institutions or agencies which function to make the cultural network and its messages visible to the members of the culture. Media ecologists, anthropologists, and linguists, for example, all serve that function and, in serving it, make the "correction" of cultural messages at least theoretically possible.

[2]Ruesch and Bateson, Communication, pp. 281-282.

As examples of messages carried by the unperceived cultural network, Ruesch and Bateson cite messages about language and linguistic systems, ethical premises, and theories of man's relation to the universe and his fellow man. These messages are not only implicit in the daily life and material culture of the individual, but are also transmitted through such media as the printed word, historical and mythological documents, and monuments.[1]

The basis for the Ruesch and Bateson model, quite clearly, is the Shannon-Weaver-Wiener model, from which such classifications as "sender," "receiver," "channel," and "destination," as well as the concepts of "receptor organs" (those structures in a communication system which, in Wiener's model, accomplish "input") and "effector organs" (those structures in any communication system which accomplish "output") are derived. Like Shannon and Weaver, moreover, Ruesch and Bateson identify three categories of descriptions of communication systems: 1) statements about the technical aspects of systems (e.g., the physical characteristics of receptors and effectors, channel capacities, time characteristics of relays, etc.); 2) statements about the semantic aspects of systems (e.g., the accuracy with which a series of symbols transmits the desired message, semantic distortion, etc.); and 3) statements about the interactional aspects of systems (e.g., the effectiveness of the transmission of information upon the behavior of people in an attempt to achieve a desired purpose). Finally, like the Shannon-Weaver-Wiener model (and, for

[1] Ibid., p. 282.

that matter, the Berlo model), the Ruesch and Bateson model serves primarily as an instrument for organizing and classifying observations of communication systems. As data organizing system, however, the Ruesch and Bateson model far surpasses either of its predecessors in both comprehensiveness and scope.

From a systems perspective, the primary strengths of the Ruesch and Bateson model lie in the facts that 1) it both identifies certain phenomena which occur in most of the specific systems which comprise the communication net and organizes those systems in a hierarchy based on the complexity of their component parts; 2) it includes in its scope a relatively wide range of subsystems and suprasystems; and 3) it stresses the principle that consideration of a subsystem or suprasystem entails a new set of elements and relationships in general (i.e., that the behavior of subsystems and suprasystems is not analogous with the behavior of the original system). The Ruesch and Bateson model (in its verbal form, at least) is, moreover, the only communication model known to the investigator which makes reference to the applications of the principles of indeterminancy and complementarity, as well as the systems principles of progressive segregation and progressive mechanization, in the study of communication systems. If the Ruesch and Bateson model provided nothing more than the principle that the position of the observer in relation to the communication system he is observing changes the nature of the system, it would make a contribution of surpassing value tc the work of media ecologists.

The Ruesch and Bateson model does, however, provide media ecologists with something more. Primarily, it suggests two complementary approaches to the study of communication systems: 1) an approach which focuses on a single "level" of communication and seeks information about the elements, variables, and interactions involved in message selection, encoding, transmission, and so on, at that level; and 2) an approach which focuses on a single process or function--e.g., coding, or transmitting, or receiving--and traces its operations through different "levels" of communication systems. Within each of these approaches, moreover, the Ruesch and Bateson model suggests three alternative points of view: a perspective which focuses on the technical aspects of the level or process under investigation, a perspective which focuses on the semantic aspects of the level or process under investigation, and a perspective which focuses on the effectivenss aspects of the level or process under investigation.

It must be pointed out here that, for all its utility as an organizing instrument, the Ruesch and Bateson model shares with the Shannon-Weaver-Wiener and Berlo models an important limitation: it fails to reflect the interactions both between the different "levels" of communication and between the elements or functions which affect the process at each level. In fact, the Ruesch and Bateson model gives, if anything, less attention to process and interaction than does the Berlo model, which, it is worth noting, gives less attention to process and interaction than the cybernetic model. Berlo provides, on the other hand, greater specification of the elements of communication than do Shannon, Weaver, and Wiener, and Ruesch and Bateson provide, in this respect, more detail than either. It would appear, then, that we may be dealing here with a principle of complementarity in the formulation of models: namely, that in model building, analysis of process and analysis of elements are complementary functions. The closer one gets to a full specification of the variables operating in communication systems, the farther away one moves from the specification of the processes through which those variables interact--and vice-versa.

In any event, what the Ruesch and Bateson model lacks as a process model it more than compensates for in its scope and comprehensiveness as an organizing system, and, as an organizing system, it has significant value for media ecologists.

A Dramaturgical Model: Goffman

As Erving Goffman points out in *The Presentation of Self in Everyday Life*, there are in general four possible perspectives which one can take in studying social systems. The first is the *technical* perspective, from which one views what is happening in terms of the efficiency of the system. The second is the *political* perspective, which focuses on the kinds of social controls and sanctions imposed by the system. The third is the *structural* perspective, which takes as its goal the description and explanation of the horizontal and vertical status divisions within the system. And the fourth is the *cultural* perspective, which deals with the moral values which influence activity within the system.[1]

To these four perspectives, Goffman has added a fifth: the *dramaturgical* perspective. As he explains, the dramaturgical perspective looks

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[1]Erving Goffman, *The Presentation of Self in Everyday Life* (Garden City, N.Y.: Doubleday & Company, Inc., 1959), pp. 239-240.

at social behavior and organization as an analogue of theatrical performance, in which "the way in which the individual in ordinary work situations presents himself and his activity to others, the ways in which he guides and controls the impression they form of him, and the kinds of things he may and may not do while sustaining his performance before them," may be analyzed and explained by reference to dramaturgical principles.[1]

Goffman acknowledges at the outset of his own work the limitations of the theatrical model of communication:

> In using this model I will not attempt to make light of its obvious inadequacies. The stage presents things that are make-believe; presumably life presents things that are real and sometimes not well-rehearsed. More important, perhaps, on the stage one player presents himself in the guise of a character to characters projected by other players; the audience constitutes a third party to the interaction--one that is essential and yet, if the stage performance were real, one that would not be there. In real life, the three parties are compressed into two; the part one individual plays is tailored to the parts played by the others present, and yet these others also constitute the audience.[2]

Despite its limitations, however, Goffman's model is a powerful instrument for understanding what he calls "closed systems," and it has had wide influence in interdisciplinary studies.

Before explicating Goffman's model, it is necessary to clarify his meaning of the term "closed system." General systems theorists, it will be remembered, use the term to refer to systems that do not exchange information or energy with their environments, and to distinguish them

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[1]*Ibid.*, p. xi.

[2]*Ibid.*

from systems ("open" systems) that do. Goffman, however, uses the term to refer to any system of social interaction, any man-made establishment designed to achieve particular goals, and to distinguish between such systems and "natural" systems such as biological organisms. Thus, by Goffman's definition, hospitals, hotels, schools, asylums, police stations, prisons, and other establishments of distinctive design are all "closed systems," although it is an essential feature of their structure that they interact with both larger and smaller environments.

Goffman's model starts from the premise that "all the world's a stage." It follows from this that in every situation, the participants are giving performances of different types or, in another term Goffman uses, "presenting" themselves. It follows, further, that one can describe, among other things, the "masks" people are wearing, the "settings" in which performances are given, the teams and "routines" that are formulated,[1] and the discrepant "roles" that are sometimes acted. Goffman, of course, dis-

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[1]Goffman's use of the term "team" is, unfortunately, a case of mixing metaphors and the literary-minded might wish he had chosen instead the term "cast" to refer (as "team" does) to "any set of individuals who cooperate in staging a single rountine." (p. 79) Goffman is aware of this lexical discrepancy, but justifies it by pointing out that the use of the word "team" allows him to indicate a conceptual correspondence between his work and the work of such game theorists as Von Neumann, from whose writing the term "team" as defined here is borrowed. In any case, a "teammate" is defined, in Goffman's model, as "someone whose dramaturgical cooperation one is dependent upon in fostering a given definition of the situation." (p. 83).

cusses in great detail every aspect of performance in a given situation, and takes great pains to develop an extensive and consistent vocabulary to assist him in his descriptions. A full explication of his model in all its detail, therefore, cannot be provided here. One extended example of a closed system and a brief analysis of it in the Goffman mode, however, may suffice to illustrate some of the key concepts in Goffman's model, and the kinds of insights it makes possible. Since it is a situation close at hand, and one with which both the writer and the reader may be expected to have some familiarity, we may take as our example the system known as a doctoral oral examination.

From Goffman's point of view, a doctoral oral examination is a complex performance which may be described as a play within a play within a play within a play, and so on. That is to say, each of the participants is, at one level, giving a performance for each of the other participants, who are, in their turns, either players or audience. At the same time, there is a larger organization of performances, in which the professors form a team cooperating in the performance of a single routine for an audience (the candidate), who, in turn, plays a solo performance for the team. At a higher level of analysis, professors and candidate together are a single team playing to the larger audience, the university. (This last point--that is, that professors and candidate constitute a team--becomes clear when one considers that, without both candidate and professors, the performance cannot take place; they are a single team because their cooperation is required to _define_ the situation.) And the university, of course, is a performer in a still larger play--scholarly tradition--and so on. Thus, to some extent, one must understand the dramaturgy of the university, and still other, larger dramaturgies, in order to understand the roles played at an oral.

Notwithstanding this, one can still make some useful observations, using Goffman's metaphor, about the performances within the oral "play" itself. The doctoral candidate will, for example, try through various strategies to project an image of quiet, respectful competence (while inside she is virtually at the edge of hysteria). But her role has, to a considerable extent, been defined by the assumptions of larger systems, and she will try to adhere as much as possible to reciting the proper dialogue. The professors, sitting in judgment, may properly be called a team. As Goffman points out,

> One over-all objective of any team is to sustain the definition of the situation that its performance fosters. This will involve the over-communication of some facts and the under-communication of others. . . . There are usually some facts which, if attention is drawn to them during the performance, would discredit, disrupt or make useless the impression that the performance fosters. These facts may be said to provide "destructive information." A basic problem for many performances, then, is that of information control; the audience must not acquire destructive information about the situation that is being defined for them. In other words, a team must be able to keep its secrets and have its secrets kept.[1]

Thus, the professors enter into a kind of tacit agreement to release only such information as will keep the situation properly defined. One professor will not normally let it be known during the performance, for example, that he thinks another professor is a fool. Nor will he let it be known that he has not read the candidate's work. Nor will he let it be known that he had already decided to pass (or fail) the candidate

[1]*Ibid.*, p. 141.

before the performance began. This information may be widely shared among the team performers "backstage" (in Goffman's model, "a place, relative to a given performance, where the impression fostered by the performance is knowingly contradicted as a matter of course,"[1] a place out of bounds to the audience, a place where the performers can relax, engage in reciprocal first-naming, elaborate griping, "sloppy" speech and posture, playful aggressiveness and kidding, etc.[2]), but it cannot be divulged "onstage" or in the "front region" without discrediting the performance. It sometimes happens, however, that a professor may play a discrepant role--for example, the role of "informer," defined by Goffman as "someone who pretends to the performers to be a member of their team, is allowed to come backstage and to acquire destructive information, and then openly or secretly sells out the show to the audience."[3] One may assume that, because the penalties for informing are severe, and because discovery is almost inevitable in the rather restricted confines of the orals situation, it is rare to find a professor in that context playing the informer's role. It is more likely, perhaps, that a professor may play on occasion the more subtle discrepant role of "shill"--in Goffman's terms, "someone who acts as though he were an ordinary member of the audience" (in this case, the professors in their role as spectator team) "but is in fact in league with the performers" (in this case, the candidate in her performing role).[4]

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[1] _Ibid._, p. 112.

[2] _Ibid._, p. 128.

[3] _Ibid._, p. 145.

[4] _Ibid._, p. 146.

It should be clear, from this brief example, that Goffman's dramaturgical model is quite rich in providing a language for describing communications in such a situation as a doctoral oral. One might discuss, for example, the ways in which the participants "upstage" each other or act roles that are "out of character" or provide each other with the proper "cues." Moreover, the metaphor appears to be applicable to a wide variety of social establishments. In this respect, it is similar to the metaphor used by those working in game theory--namely, that social interactions can be viewed as various forms of games, with specific rules and carefully delineated roles. Goffman's model may be identified, in fact, as a special case of game theory, for dramaturgy itself is a game, or more accurately, a series of different games.

From a systems point of view, Goffman's model has much to recommend it. In the first place, it takes into account the interactions among different levels of systems. To return to the doctoral oral, we can describe the performances given there with minimal reference to the larger system, but we cannot explain those performances unless we refer to the university itself. In order to explain, for example, why professors behave as they do at orals, we must know something of the play in which an oral is merely one scene. In order to explain discrepant roles or out-of-character routines, we also need to know something of the other teams to which each professor, and the candidate, belongs, something of the performances for which those teams are established, and something of the roles professors and candidate have played with each other in other performances. A professor may assume the role of "shill" at an oral, for example, because in another context (a "departmental" or "program performance") he and the candidate are members of the same team. Another may assume the role of "informer" because, in another context (the "faculty council performance") he and the other professors on the doctoral committee are on opposing teams.

Thus, Goffman's model calls attention to the "systems within the systems within systems" (or "plays within plays within plays") that the systems perspective is so concerned with. Moreover, it stresses the point that the function (or role) of any element in a system (or participant in a performance) is determined by the structure of the system as a whole (the play), and, conversely, the structure of the system (the performance) is determined by the functions of the elements (the roles each player assumes). Beyond this, Goffman's model focuses attention on the dynamic nature of interaction. The metaphor of dramaturgy is an active conception. One is encouraged to see interactions as a series of performances for audiences. The performances, moreover, are controlled in various ways by the responses of the audience.

Goffman's model is also compatible with the assumptions, needs, and perspectives of media ecologists. Goffman is always concerned to describe the setting (or environment) in which the play takes place; the media ecologist places similar stress on the communication environment, whether it is a room in a university or a television set. Goffman is also concerned with the "masks" people wear, and, of course, the kinds of performances their situation compels them to give. Translated into media ecology terms, the Goffman model focuses attention on the states of mind media environments compel people to assume. In fact, using Goffman's model as a base, a media ecologist might be able to work out a classification system for media based on the kinds of roles each medium induces the audience to play. In stressing the point that the play structures not only the response of the audience, but also the performances of the players, moreover, Goffman's model suggests another line of application. It may provide useful insights, for example, into the reasons why certain people can or cannot give adequate performances through certain media. Some people are good speakers but poor writers. Is speech as theatre so different from writing (e.g., in the distance between the stage and the audience) that totally different acting skills, as well as a different psychological set on the part of the performer, are required? If so, how are these "theatres" different, and what are the appropriate rules for satisfactory performance in each?

One must be cautious, of course, in extending any metaphor too far. As Goffman himself points out, in summarizing his model at the conclusion of The Presentation of Self in Everyday Life,

> In developing /this/ conceptual framework . . . some language of the stage was used. I spoke of performers and audiences; of routines and parts; of performances coming off or falling flat; of cues, stage settings, and backstage; of dramaturgical needs, dramturgical skills, and dramaturgical strategies. Now it should be admitted that this attempt to press a mere analogy so far was in part a rhetoric and a maneuver.[1]

In admitting this, however, Goffman does nothing more than underscore the function of all models: to generalize, exaggerate, and focus attention on particular aspects of complex situations, to serve as "scaffolds," in Goffman's own phrase, "to build other things with."[2] In the dramaturgical

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[1]Ibid., p. 254.

[2]Ibid.

model, Goffman provides media ecologists primarily with a way of talking about complex communication environments and processes, and a reasonable way of organizing and even explaining a wide range of observations of human communication behavior. As a scaffold, in short, it is very much worth retaining--at least until we have constructed some more dependable structure for explaining communication that lets us take it down.

An Anthropological Model: Sapir, Whorf, Lee, et. al.

In the interdisciplinary readings surveyed by the investigator, the most frequently cited communication model drawn from the field of anthropology was the model which is sometimes referred to as the Whorfian Hypothesis. This model, nowhere depicted diagramatically,[1] is in essence an assertion of a relationship; specifically, of a relationship between language and culture; and even more specifically, that culture is a function of language. Its basic premise is that the traditional, absolutist view that what is, is (i.e., that "reality" is the same for everay man), is untrue. In the traditional view, it is held that "the cognitive processes of all human beings possess a common logical structure.. . . which operates prior to and independently of communication through language."[2] The perspective suggested by metalinguistics (the

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[1]In "A Systematization of the Whorfian Hypothesis," Behavioral Science, V (1960), pp. 323-339, Joshua A. Fishman offers a diagram of the levels of research suggested by, and kinds of data needed to substantiate, the Whorfian Hypothesis, but this is in no sense a representation of the model itself.

[2]Franklin Fearing, "An Examination of the Conceptions of Benjamin Lee Whorf in the Light of Theories of Perception and Cognition," in Language in Culture, ed. by Harry Hoijer (Chicago: University of Chicago Press, 1954), p. 47.

term most frequently used to subsume the Whorfian Hypothesis), on the other hand, is that linguistic patterns contribute powerfully in determining how the members of a particular speech community perceive their world and think about it.

It is probably necessary to point out here that the investigator does not wish to enter into the debate over the extent to which the Whorfian model has been substantiated (or can be substantiated) in acceptable scientific terms. Suffice it to say that serious arguments have been raised against it, most notably and recently by Noam Chomsky, who has, in fact, postulated the existence of a "universal grammar" and, by extension, a "universal logical structure."[1] The significant point for our purposes here, however, is that anthropologists have been drawn to the metalinguistic theory of communication and culture for more than half a century, and continue to find it both compelling and suggestive.

One of the first anthropologists to advance this view was Franz Boas. As early as 1911, he wrote, "It seems that a theoretical study of Indian languages is not less important than a practical knowledge of them; that the purely linguistic inquiry is part and parcel of a thorough investigation of the psychology of the peoples of the world."[2]

A similar view was expressed by other anthropologists, such as Bronislaw Malinowski and, especially, Edward Sapir. Sapir gave his

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[1]See, for example, Noam Chomsky, Language and Mind (New York: Harcourt, Brace & World, 1968); Chomsky's model is also reviewed in this chapter, pp. 251-254.

[2]Franz Boas, Handbook of American Indian Languages, cited by Harry Hoijer in "The Sapir-Whorf Hypothesis," Language in Culture, p. 92.

first expression to the metalinguistic conception of language and culture in 1929, when he wrote that "Language is a guide to social reality. . . . Human beings do not live in the objective world alone ... but are very much at the mercy of the particular language which has become the medium of expression for their society."[1]

The most widely known expression of this idea, however, was offered by Sapir's student, Benjamin Lee Whorf. In Language, Thought and Reality,[2] Whorf asserts that even when the physical evidence is the same, different cultures may derive very different pictures of the universe because of the linguistic patterns in which their ideas come to be formulated. Natural categories, Whorf argues, are not provided by reality, although lingusitic categories tend to make us assume that they are:

> We all, unknowingly, project the linguistic relationships of a particular language upon the universe, and see them there. . . . We say "see that wave"--the same pattern as "see that house." But without the projection of language no one ever saw a single wave. We see a surface in everchanging, undulating motion. Some languages cannot say "a wave"; they are closer to reality in this respect. Hopi say walatata, "plural waving occurs," and can call attention to one place in the waving just as we can. But, since actually a wave cannot exist by itself, the form which corresponds to our singular, wala, is not the equivalent of English "a wave," but means "a slosh occurs," as when a vessel of liquid is suddenly jarred.
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> English pattern treats "I hold it" exactly like "I strike it," "I tear it," and myriads of other propositions that refer to actions effecting changes in matter. Yet "hold" is in plain fact no

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[1]David Mandelbaum, ed., Selected Writings of Edward Sapir (Berkeley, Cal.: University of California Press, 1949), p. 162.

[2]Benjamin Lee Whorf, Language, Thought and Reality: Selected Papers, ed. by John B. Carroll (Cambridge, Mass: M.I.T. Press, 1956).

> action, but a state of relative positions. But we think of it, even see it, as an action, because language sets up the proposition in the same way as it sets up a much more common class of propositions dealing with movements and changes. We ascribe action to what we call "hold" because the formula, substantive + verb = actor + his action, is fundamental in our sentences. Thus we are compelled in many instances to read into nature fictitious acting-entities simply because our sentence patterns require our verbs, when not imperative, to have substantives before them. We are obliged to say "it flashed" or "a light flashed," setting up an actor, it, or a light, to perform what we call an action, flash. But the flashing and the light are the same; there is no thing which does something, and no doing. Hopi say only rehpi. Hopi can have verbs without subjects, and this gives to that language power as a logical system for understanding certain aspects of the cosmos.[1]

While no other writer has stated quite so clearly or forcefully as Whorf the hypothesis which, consequently, bears his name, several anthropologists have made significant contributions to its development and application. Dorothy Lee, for example, took the Whorfian Hypothesis as a starting point in her contrastive analysis of Trobriand Island language and culture with American English language and culture. One of her findings was that the grammatical structure of English, unlike that of Trobriand speech, enforces a lineal perception of reality which is further codified in our vocabulary and metaphors. As she puts it,

> In our own culture, the line is so basic that we take it for granted, as given in reality. We see it in visible nature, between material points, and we see it between metaphorical points such as days or acts. . . .
>
> The line is found or presupposed in most of our scientific work. It is present in the induction and deduction of science and logic. It is present in the philosopher's phrasing of means and ends as lineally connected. Our statistical facts are presented lineally as a graph or reduced to a normal curve. And all of us, I think, would be lost without our diagrams. We trace a historical

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[1]*Ibid.*

> development; we follow the course of history down to the present and up from the ape. . . .
>
> When we see a line of trees or a circle of stones, we assume the presence of a connecting line which is not actually visible. And we assume it metaphorically when we follow a line of thought or a course of action or the direction of an argument; when we bridge a gap in the conversation, or speak of the span of life or of teaching a course, or lament our interrupted career. We make children's embroidery cards and puzzle cards on this assumption; our performance tests and even our tests for sanity often assume that the line is present in nature and, at most, to be discovered or given visual existence.[1]

Thus, the general model of the communication process being put forward here is that language is not properly thought of as a "medium" or "vehicle" of thought, but as the material of thought itself, or at least, a profound determining factor in what "thoughts" are thinkable. Moreover, it is also asserted that how one thinks (i.e., uses language) literally governs how one will see the physical world and the relationships within it. Whorf stresses in particular that the grammatical structure (including its arrangments for expressing time and space relationships) and vocabulary (modes of classifying) of any particular language are the key elements in fashioning one's world view. Thus, the metalinguistic model may be represented pictorially as in Figure 14.

In other words, the biases, presuppostions, and limitations of one's language are projected onto the "objective" world, so that we see it in the ways our coding system "packages" it.

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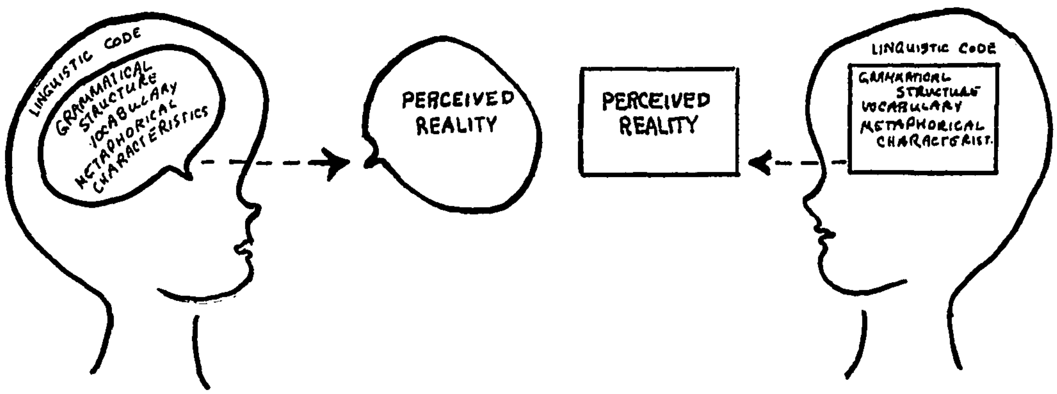
[1]Dorothy Lee, Freedom and Culture (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1959), pp. 110-111.



Whorf, Sapir, and Lee: Language and Reality

Figure 14

Perhaps the most striking aspects of this conception are as follows. First, the Whorf-Sapir model appears to be an elaboration, in larger terms, of the Ames model of perception; that is, what Ames postulated as true for individuals, the Sapir-Whorf model postualtes as true for entire cultures.[1] Second, the Sapir-Whorf model blends quite compatibly with the principles of both systems theory and media ecology. There is great stress in the Sapir-Whorf model, for example, on the transactional nature of communication: the individual is not represented as a passive recipient of incoming data, but as an active selector and shaper of what data are perceived and how they are to be understood. Moreover, the Sapir-Whorf model suggests

[1]The Ames model is summarized on pp. 255-262 of this report.

that in order to understand the dimensions and character of a culture, one must focus attention on one of the subsystems--language--that comprise it. At the same time, of course, it must be noted that the Sapir-Whorf model largely neglects the role of other major subsystems--e.g., such non-verbal systems as geography, climate, and natural resources--in shaping not only the structure of language, but the structure of social institutions as well.

Nonetheless, the metalinguistic model is responsive to many, if not all, of the questions posed by media ecologists. In fact, several of the scholars whose names are included almost without exception in media ecology bibliographies have advanced a view not dissimilar to that represented in the Sapir-Whorf model. Harold Innis (in The Bias of Communication)[1] and Marshall McLuhan (in Understanding Media),[2] for example, put forward an almost identical model, with the exception that their definition of a code or symbol system goes far beyond literal language. In essence, they assert that culture is a function of media of communication, and, in particular, of the structure of the dominant media of communication in any society. Insofar as it can be conceptualized visually, the Innis-McLuhan model might be represented as in Figure 15.

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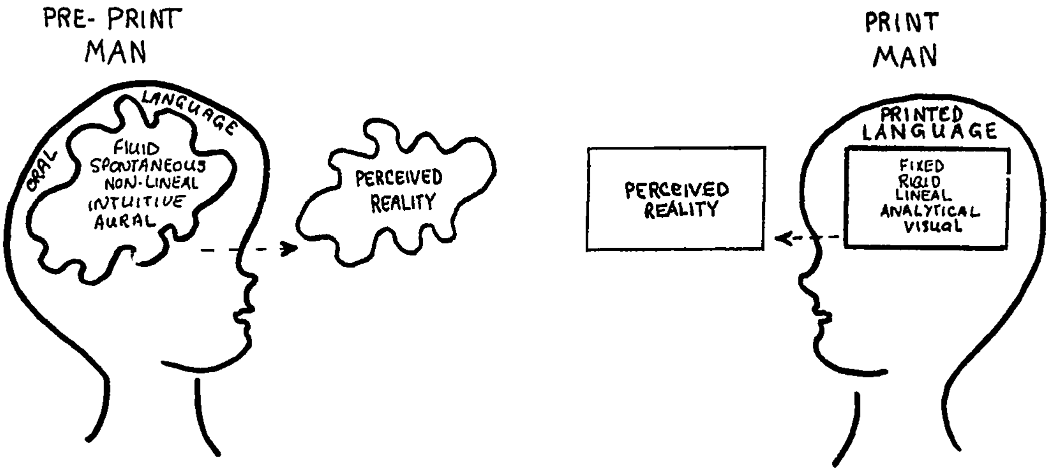
[1]Harold A. Innis, The Bias of Communication (Toronto: University of Toronto Press, 1951).

[2]Marshall McLuhan, Understanding Media: The Extensions of Man, McGraw-Hill Paperbacks (New York: McGraw-Hill Book Company, 1965).



A Visual Conception of the Innis-McLuhan Model

Figure 15

In effect, what Innis and McLuhan have done is to try to specify the kinds of biases various media might impose on modes of perception, feeling, and intelligence. In this respect, their work parallels that of Sapir, Whorf, Lee, and other anthropologists who have tried to specify the kinds of biases various languages might have.

One seeming difficulty with the Sapir-Whorf model (and, by extension, with the Innis-McLuhan model) is that it asserts a relationship that is almost impossible to document. As Joshua Fishman has pointed out, it is easy enough to demonstrate that two languages (e.g., English and Hopi) have strikingly different grammatical structures and modes of classification. But the essential research problem is to show that these differences make a difference in perception and other nonverbal behaviors.[1] Since it is postulated that each of us is locked into a special psychological and social reality by our language, how can experiments be designed that free us from our biases? This has been exceedingly difficult to do, although some attempts have been made--for example, by Roger Brown and Eric Lenneberg.[2] It may well be that we are dealing, in our attempts to verify the Whorfian Hypothesis, with a kind of principle of indeterminancy; that is, we can guess that our own modes of perception are different from, say, the Hopi's, but as soon as we try to specify those differences we must use language itself, and, therefore, cannot make bias-free or "objective" statements about the matter. (In principle, it should be somewhat easier to verify the Innis-McLuhan hypothesis, but very little work has so far been done in this area.)

In any case, the major value of the Sapir-Whorf model would appear to be as a heuristic tool. The model may or may not be verifiable, but it is highly suggestive and opens several lines of inquiry to students of communication and culture. If we assume, for example, that linguistic structure does influence modes of perception, what differences in social organization between cultures could be explained by reference to linguistic differences? What differences might we expect in political orientation, or

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[1]Fishman, "A Systematization of the Whorfian Hypothesis," p. 326.

[2]Ibid., pp. 326-332.

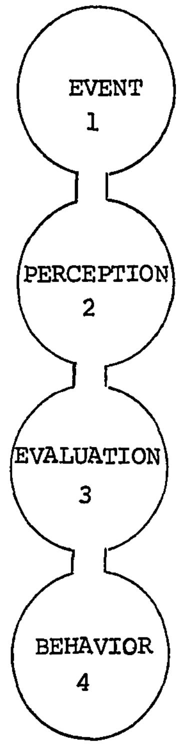
in religious systems, and so on? To what extent can changes in linguistic structure or elements be deliberately imposed on a culture, and can such changes bring about a change in modes of cultural perception and organization? In regard to the last question, it is worth noting that in recent years, several efforts have been made--more or less consciously--to bring about perceptual and behavioral changes in our own culture through linguistic manipulation. The "black awareness" movement of the past decade, for example, relied heavily on changes in language to reinforce, if not actually create, a new "black consciousness." The current emphasis in the "women's liberation movement" on lexical change (e.g., Ms. in place of Miss or Mrs., chairperson for chairman, and so on) may also be regarded as a kind of experiment derived from the Whorfian Hypothesis. The results of such attempts at bringing about perceptual change through linguistic change are, unfortunately, extremely difficult to assess. In some cases, it seems quite clear that a lexical change genuinely alters perception and behavior--especially in such carefully controlled contexts as scientific research, where, as Einstein once noted, language and language change have been of preeminent importance in the generation of new perceptions and discoveries. In other situations, however, lexical change seems to have little or no effect; people simply attribute old meanings (and bring old perceptions) to the new linguistic structures. In the common parlance, for example, psychosomatic (as in the phrase psychosomatic illness) has simply acquired old meaning, "psychological," and the new structure space-time (to the extent that it is used in popular speech at all) has acquired the older meaning of "space." These facts all by themselves, however, suggest a whole line of research for media ecologists.

In what contexts do changes in language seem to be accompanied by changes in perception and behavior? What are the significant characteristics of those contexts? What *kinds* of linguistic changes seem to produce changes in perception and behavior? Lexical change? Structural change? Is the deletion of words from a culture's vocabulary (e.g., *ether*, *humours of the blood*), the addition of totally new words (e.g., *quark*), the creation of "hybrids" (e.g., *pschosomatic*, *space-time*, *media ecology*), or the redefinition of existing words (e.g., *alcoholism* to mean "illness" rather than "moral degeneracy") more effective in producing change in a culture's perceptions and behavior?

The Sapir-Whorf model of the communication-culture relationship, in short, suggests not only a wide range of questions for the media ecologist, but some potentially testable hypotheses as well. Perhaps it is appropriate to stress here that a model need not be "correct" in order to be useful. We know, for example, that neither Ptolemy's model of the universe nor Copernicus's was correct (in terms of our present understanding), but each in its way led to significant advancement of knowledge. The Sapir-Whorf model may not have quite the same status as Ptolemy's or Copernicus's, but it can serve the same function.

The General Semantics Model: Korzybski, Hayakawa, et al.

As Joseph DeVito suggests, in his visual representation of the concerns of general semantics (Figure 16), the general semantics model of communication is addressed primarily to the relationships between reality and human perception, evaluation, and behavior. More specifically, the model deals with the role of language and other symbol systems in the abstracting, perceiving, evaluating processes, and the ways in which those processes, codified in symbol systems, affect human behavior.



The Concerns of General Semantics[1]

Figure 16

The general semantics model is composed of several elements, including both diagrammatic and verbal representations. The original general semantics model, developed by Alfred Korzybski in 1933,[2] centers

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[1]Joseph A. DeVito, General Semantics: Guide and Workbook (Deland, Fla.: Everett/Edwards, Inc., 1971), p. 2.

[2]Alfred Korzbyski, Science and Sanity (Lakeville, Conn.: International Non-Aristotelian Library Publishing Company, 1933).

around a complex three-dimensional construction called the Structural Differential, which cannot, unfortunately, be reproduced here. The model is most frequently represented in the interdisciplinary literature in communication, however, in a variety of more manageable forms developed by such interpreters of Korzybski's work as S. I. Hayakawa, Wendell Johnson, Stuart Chase, and, more recently, Joseph DeVito.[1] While Hayakawa's interpretation of general semantics in Language in Thought and Action, and the adaptation of the Structural Differential he provides there (in the form of an "abstraction ladder")[2] is probably the most well known of the variations on Korzybski's model, the most accurate representation of it (in the investigator's judgment) is provided by DeVito in The Psychology of Speech and Language: An Introduction to Psycholinguistics. DeVito's representation of the central element in the general semantics model, the Structural Differential, is reproduced in Figure 17.

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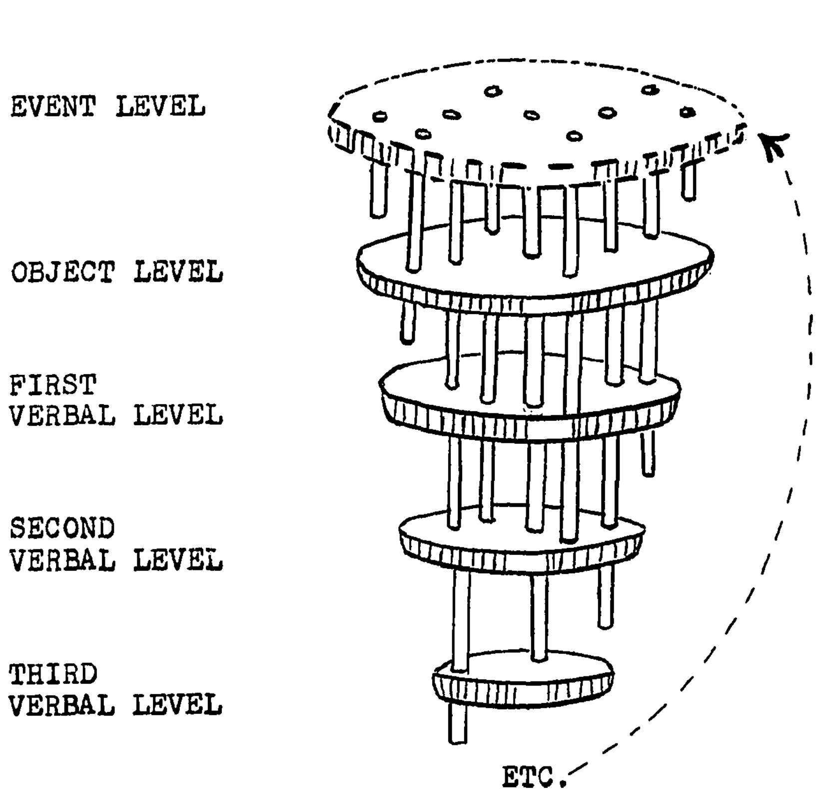
[1]S. I. Hayakawa, Language in Thought and Action (New York: Harcourt, Brace & Company, 1947); Wendell Johnson, People in Quandaries (New York: Harper and Brothers, 1946); Stuart Chase, The Power of Words (New York: Harcourt, Brace & World, 1954); Joseph A. DeVito, The Psychology of Speech and Language: An Introduction to Psycholinguistics (New York: Random House, 1970), and General Semantics: Guide and Workbook.

[2]Hayakawa's "abstraction ladder" is represented in Figure 18, on p. 233.



General Semantics: The Process of Abstraction[1]

Figure 17

The model in Figure 17 is intended to depict the different levels of abstraction through which human beings can know the world. According to DeVito's representation, the highest level of abstraction (and the lowest, a paradox that will be explained in a moment) is called the "event level." This represents what may be called "the real world" of events and processes. It is a world which we cannot perceive directly,

[1]DeVito, <u>The Psychology of Speech and Language</u>, p. 16.

for it is the world of swirling electrons, neurological and chemical processes, and submicroscopic physical transformations. The event world is characterized by 1) infinite complexity, 2) constant change, and 3) non-identity--that is, it is a world in which no two things are ever identical. The circle representing this level is broken to suggest that any event in reality is infinite; and the tiny circles represent the infinite characteristics of any event.

The characteristics of the event world, or reality, can only be inferred from data provided by the next stage of the abstraction process, the "object level." The object level is the level of sense perception--the world of sight, touch, taste, smell, hearing, and so on. The object level is an abstraction--the result of a selecting process--derived from the event level. In other words, we cannot see, hear, touch, smell--in a word, perceive--everything that is occurring in reality, but only some small portion of an infinitely complex event. Those characteristics of the event which can be perceived are represented by the poles that penetrate the object level circle; those that cannot be perceived are represented by the poles that do not penetrate, or even reach, the object level circle. The set of phenomena at the object level is 1) finite in number, and 2) limited by the nature of our perceptual systems.

DeVito characterizes the difference between the event level and the object level in the following way:

> . . . on the event level we have what we call molecules in motion. But these are not abstracted on the object level; we do not see molecules in motion. Rather, if we touch a surface we may feel "heat" or "coldness" depending on the speed of the molecules. The heat or coldness, however, does not exist on the event level. Complex processes exist here. The interactions of these molecules in motion with our own nervous system produces the sensations of heat and cold. Because our perceptions on the object level are a function not only of what exists on the event level but also of our own nervous systems, different people will respond differently to the "same" event.[1]

Both the event and the object levels are nonverbal levels; they are part of the world of non-words. The third level of the abstracting process, or the "first verbal level," however, represents the level of concrete naming and of factual and descriptive statements about our perceptions. (The last word in the preceding sentence is stressed to emphasize the point that words and statements are never about the event level, but only about the object level.) Concrete statements such as "Henry Perkinson is wearing a blue suit," would be examples of phenomena at the first verbal level. Once again, the penetrating poles in the diagram represent what one has selected to say about the object as he perceives it; the poles that do not connect with the first verbal level represent all the object level perceptions that are omitted from verbal categories (i.e., names) and descriptive statements.

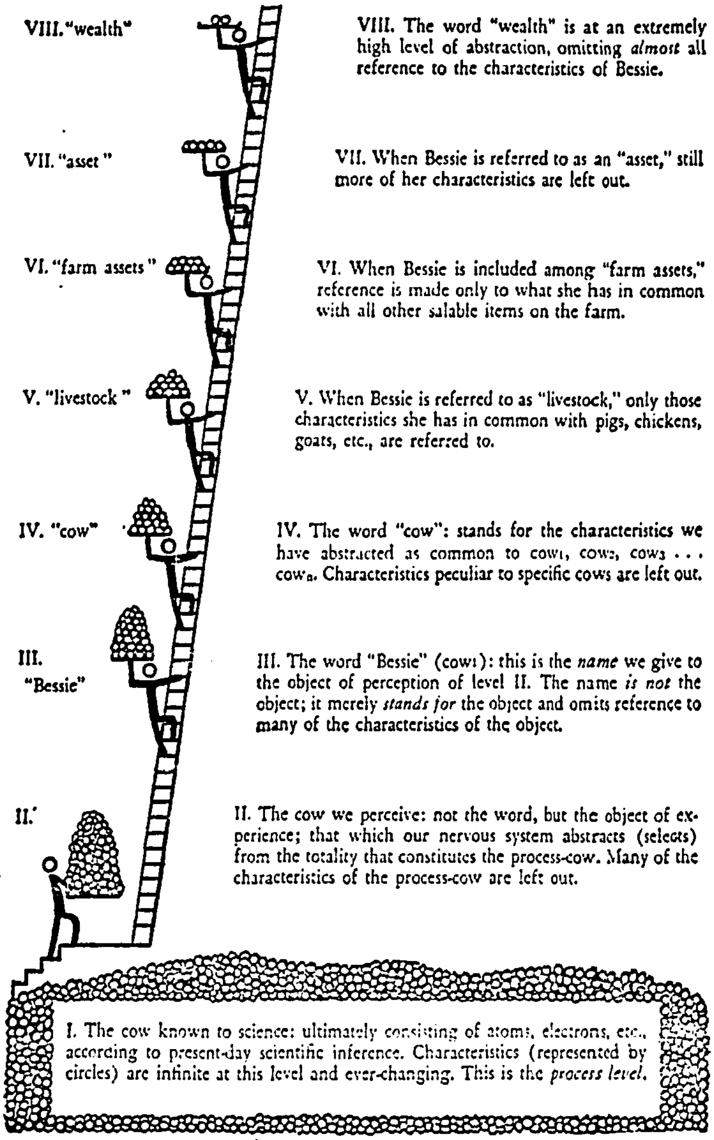
The "second verbal level" (the fourth level of the abstracting process) represents phenomena such as class terms (Protestant, Democrat, professor, student, etc.), inferential statements (statements about the

[1]DeVito, General Semantics, p. 5.

unperceived based on the perceived, such as "Henry Perkinson's suit has recently been cleaned"), and statements about statements (for example, "Henry Perkinson always tells the truth"). The second verbal level also includes generalizations and theories--that is, statements about a diverse variety of perceptions. The poles in the model once again represent the exclusion and inclusion process.

The "third verbal level" (which can also be thought of as the fourth, fifth, sixth, etc., level), represents the level of language at which generalizations can go on indefinitely--that is, statements about statements about statements, and so on. The last sentence (and, for that matter, most of the sentences in this communication) is an example of a phenomenon at the third verbal level. That is, it is a generalization about DeVito's statements, which are in turn generalizations about statements, which are in turn generalizations about statements, and so on. In short, we are dealing at the third verbal level with language that is only remotely related to events and perceived objects in the external world.

As depicted by DeVito, the general semantics model suggests visually that generalizations, theories, and exceedingly abstract statements are "low" order abstractions (that is, they are visually represented as the lower layers in a hierarchy). This is a disturbing problem in a language whose prevalent bias is to conceive successive generalizations as movements up on a vertical line, not down. Perhaps that is why S. I. Hayakawa, in his interpretation of the Structural Differential, reverses the visual representation of the abstracting process. In his model (Figure 18), the event level is at the bottom of the "ladder," and the highest verbal levels are at the top.



General Semantics: Hayakawa's "Abstraction Ladder"[1]

Figure 18

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[1]Hayakawa, Language in Thought and Action, p. 169.

To return, however, to DeVito's model: The arrow in Figure 17 is intended to suggest that statements at the highest verbal level are projected onto the event level, so that our language does, in some sense, influence what is happening (that is, what we conceive to be happening) at the event level. The paradox here is that both the event level and the third verbal level are equally abstract conceptions, and could be called either "higher" or "lower" order abstractions. This is a weakness in the form of the model, and will be discussed presently.

The basic purpose of the model represented in Figure 17, and of virtually all general semantics models, is to depict the structural relations between "reality" (the world outside our skins) and our habitual modes of perceiving and describing reality. The model asserts that events in the "real" world are never identical, can never be fully perceivable, and therefore can never be adequately understood or expressed. Our methods of abstracting, however, lead us to see things and, perhaps more important, talk about things as if they were identical, knowable, and communicable. Thus, the three basic principles generated by the general semantics model are 1) the principle of non-identity--no two things are identical; 2) the principle of non-allness--we can never know or say all about anything; and 3) the principle of self-reflexiveness--language can be used at many different levels and, in fact, can be used at such a level of abstraction that it no longer refers to anything in the external world.

In systems terms, the general semantics model deals with the interaction between reality and the human nervous system, including its various coding subsystems. The form of the model indicates that this interaction occurs in a hiearchical manner, and implies that we are in the closest possible connection with reality when we are not engaged in talking or symbolizing but are, instead, allowing our senses to apprehend "directly" so to speak, what is "out there." At the same time, the arrow which goes from the third verbal level back to the event level helps to emphasize the point that symbols (linguistic or non-linguistic) are inevitably implicated in the work of our senses, in that the structure of our codes organizes the ways in which we will see, hear, touch, smell, and so on. In this regard, there appear to be two significant deficiencies in the structure of the model. The first lies in the placement of the arrow intended to indicate "feedback" of a sort from the third verbal level. It is a fundamental assumption of the general semantics model that there is a real structure to the world outside our skins which is, in fact, indifferent to our modes of apprehending or talking about it. Thus, while language (or any other code) can affect our perceptions (the object level), it cannot affect what is "really" there. The feedback arrow from the third verbal level, therefore, should connect with the <u>object</u> level, not (as it does) with the event level.

A second structural deficiency in the model, in the investigator's view, lies in its vertical arrangement and, more specifically, in its placement of the "event level" at the top. Inverting the model (as Hayakawa does) does not correct what seems to the investigator to be a misconception: namely, that the sub-microscopic world, the world of "swirling electrons," or even of "electromagnetic fields," is more "real"--that is, less abstract--than the world of sensory experience. In human experience, it seems to the investigator, the most concrete "level" is the world as it interacts with our senses, and both the verbal (suprasensory) and sub-microscopic (subsensory) worlds are equally abstract. The investigator proposes, therefore, that the different "realities" represented in the general semantics model be depicted on a horizontal continuum, in which sensory reality stands at the midpoint and progressive abstractions, of either the subsensory or suprasensory type, lead off to the left and right. This modification serves, in the investigator's view, two valuable purposes. First, it deletes from the model the judgmental overtones always suggested in a vertical organization that stresses "levels," and second, it permits the observations that subsensory phenomena of different categories (e.g., the microscopic world, the submicroscopic world, and the world of "force fields") are removed at different distances from human experience, and that phenomena at either end of the scale (subsensory or suprasensory) are equally far removed from sensory reality and are, therefore, equally unreliable sources of knowledge.

As noted above, the vertical form of the general semantics model (as represented in both Figure 17 and Figure 18) carries judgmental overtones, and here it must be said that this characteristic of the model is neither accidental nor trivial. In fact, one of the major assumptions of general semantics is that there is a "correct" way of evaluating what is going on outside our skins, and an "incorrect" way. The model is, in short, intended not merely to describe, but to provide a standard for judging, the relationship of language to reality. That standard is, in general, closely identified with scientific concepts--for example, that our statements ought to be verifiable, operational, and descriptive. The general semanticists call this standard "extensionality." The more one moves away from scientifically acceptable modes of description and evaluation, the more one moves toward "intensionality"--perceptions and statements that have more to do with the state of one's nervous system than the state of reality. (Of course, it should be noted that, in recent years, science--as represented in the work of the modern physicists, for example--has itself moved away from extensionality toward intensionality.)[1]

In any case, if one accepts the scientific standard, the general semantics model can be applied as an evaluative instrument to a wide variety of statements about the world. One can, for example, use it to judge the language of politics, of education, of commerce, of advertising, and so on. Specifically, one may ask about such "languages" questions like, To what extent can these statements be verified? What do they leave out? Has the categorizing process blurred important distinctions? Has it created distinctions that unnecessarily distort the connectedness of things in reality? Have symbols been confused with the realities they are intended to represent?

When the function of communication is something other than a sharing of information about "extensional" events, however, the general semantics model is not very useful. For example, it says almost nothing about the sharing of feelings, or about the function of art, music, poetry, or religion. Thus, insofar as it implies that the sole purpose of language is the accurate reflection of a unidimensional reality (i.e., sensory reality), it is seriously limited.

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[1]See, for example, Percy W. Bridgman, The Way Things Are (Cambridge, Mass.: Harvard University Press, 1959).

On the other hand, the general semantics model can serve an important function in media ecology as an analogue for describing the relationship of symbol systems other than language to the processes of perceiving, evaluating, and responding to reality. It suggests, for example, that the structure of _any_ medium can determine perception, that every medium (linguistic or non-linguistic) has structural biases, and that every medium, therefore, has particular psychological biases. It also suggests that the structural and psychological biases of a medium can be identified and, once specified, compensated for through the use of "corrective" devices or techniques. To compensate for the structural biases of language, for example, general semanticists urge the use of such techniques as _indexing_ ($politician_1$ is not $politician_2$) to remind ourselves of the principle of non-identity; _dating_ ($politician_{1970}$ is not $politician_{1972}$) to remind ourselves that everything is in a process of change; and "etceterizing" (adding "etc." to statements) to remind ourselves of the principle of non-allness. One interesting line of questioning this might suggest to media ecologists is to what extent "corrective" techniques can be developed to compensate for the structural biases of media such as film, television, radio, and so on.

It must be noted, in concluding, that the general semantics model has, in fact, been used to achieve two important purposes. The first, as suggested earlier, has been to make people more aware of the causes of certain kinds of communication breakdowns--for example, difficulties arising from confusions in the denotative and connotative uses of language, levels of abstraction, and symbol-reality correspondence. And the second has beem to generate and give focus to research in both psychology and anthropology.

In psychology, the general semantics model has focused attention on the role of the abstracting process in mental health and mental illness, and has, moreover, led to research into the question, Why do people abstract one thing rather than another? And in anthropology, general semanticists have been closely allied with the linguistic anthropologists (Sapir, Whorf, Hoijer, Kluckhohn, and Lee, for example) in generating questions and information about the relationship of linguistic biases to modes of cultural perception and organization.

Because the general semantics model so easily invites inquiries into both the systems functioning within the individual and the larger systems of which the individual is a part, it is an interesting tool for the media ecologist. However, its lack of specificity, its indifference to context, and its failure to account for the varieties of purposeful human communication are serious weaknesses.

A Philosophical Model: Charles Morris

The work of Charles Morris, particularly as it is synthesized in *Signs, Language and Behavior*,[1] has had considerable impact on interdisciplinary studies in communication. This is not surprising, since Morris explicitly attempted to "lay the foundation for a comprehensive and fruitful science of signs,"[2] or, in other words, to develop a system for

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[1]Charles Morris, *Signs, Language and Behavior* (New York: George Braziller, Inc., 1946).

[2]*Ibid.*, p. v.

classifying modes of communication. In developing his model, Morris drew abundantly from the work of Charles Pierce, C.K. Ogden and I.A. Richards, George Herbert Mead, and others who had attempted to construct theories about the function of language, and whose work plays an important role in interdisciplinary studies in communication. His model reflects, therefore, much of the most significant work done in communication on the subject of codes and coding.

As a preface to explicating the Morris model, it must be noted that, while in virtually all the examples provided, Morris deals exclusively with language, he does not conceive his theory to be confined to linguistic modes of signification--and, indeed, it is not so limited, but provides a basis for classifying nonverbal, media-produced signs as well. Thus the references to language in the following summary must be interpreted solely as illustrations of Morris's system, not as limiting cases of its application.

Morris's original model for the classification of modes of signifying and types of discourse, as it appears in Signs, Language and Behavior, is reproduced in Figure 19.

What Morris is attempting in his model is the classification of types of discourse both in terms of a dominant mode of signifying and a primary usage. By mode, Morris means the formal characteristics of the language itself, and by usage, he means the purpose to which language in a particular mode may be put. As Morris says of his classification system, "Pairing the four main modes with the four main usages gives sixteen major types of discourse. . . . Then the problem is to investigate the relation of these sixteen possibilities to the specializations

Use / Mode	Informative	Valuative	Incitive	Systemic
Designative	Scientific	Fictive	Legal	Cosmological
Appraisive	Mythical	Poetic	Moral	Critical
Prescriptive	Technological	Political	Religious	Propagandistic
Formative	Logico-mathematical	Rhetorical	Grammatical	Metaphysical

Morris: The Major Types of Discourse[1]

Figure 19

of language currently employed and distinguished."[2] In other words, Morris's model has as its major purpose the organization of research. But his attempt to classify modes of signification (as designative, appraisive, prescriptive, and formative) has apparently been too confusing for practical use in conceptualizing the communication process, as evidenced by the fact that virtually no references are made to the model as a whole

[1] Ibid., p. 125.

[2] Ibid.

in interdisciplinary readings in communication.[1] Instead, stress is placed on two aspects of Morris's model: the uses of discourse and the various specializations of language.

Simply, Morris contends that language is used for four major reasons. As he puts it,

> Signs . . . may be used to inform the organism about something, to aid it in its preferential selection of objects, to incite response-sequences of some behavior family, and to organize sign-produced behavior (interpretants) into a determinate whole. These usages may be called in order the informative, the valuative, the incitive, and the systemic uses of signs.[2]

It follows from this that the criteria for adequacy in the uses of language will vary from use to use. For example, when the primary use of language is informative, Morris contends, "convincingness" is the criterion of adequacy.[3] The criterion for adequacy in valuative language is effectiveness;[4] the criterion for adequacy in incitive language is persuasiveness;[5] and the criterion for adequacy in systemic language is correctness.[6]

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[1]Morris himself suggests a good reason why his distinction between "modes" and "uses" of discourse did not take hold. "It is obvious," he says, "that the four comprehensive usages of signs are closely related to the four modes of signifying. The primary use of designators is informative, the primary use of appraisors is valuative, the primary use of prescriptors is incitive, and the primary use of formators is systemic. So close in fact is this relationship that doubt may be raised as to whether the mode of signifying a sign can be distinguished from its corresponding primary usage." Signs, Language and Behavior, p. 96.

[2]Ibid., p. 95.

[3]Ibid., p. 97

[4]Ibid., p. 99.

[5]Ibid., p. 102.

[6]Ibid., p. 104.

Morris has considerable difficulty in explaining the distinguishing characteristics of such terms as convincingness, effectivess, and persuasiveness. But his own failure to make these distinctions clear has apparently not retarded others from doing so. In general, Morris's model has been interpreted in the following way: There are four major uses of language. One is to inform, and its major characteristic is that it is descriptive or reportorial. A second is to evaluate, and its major characteristic is that it expresses the attitude of the speaker toward that which he is describing. A third is incitive, and its major characteristic is that it causes an interpreter to act in a particular way. A fourth is systemic, and its major characteristic is that it clarifies language itself. It is language about language--specifically, the stipulation of what rules of discourse govern a particular situation.

No doubt this mode of classifying language is vastly oversimplified, but it has quite naturally led to an interest in a second aspect of Morris's model--namely, his conception of specialized languages, such as the language of science, the language of poetry, the language of religion, the language of politics, and so on. Morris himself did no research on the characteristics of specialized languages, but others have.[1]

The main contribution of Morris's model, then, is that it tries to distinguish among the various uses of language, and suggests some fruitful

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[1]See, for example, Language in America, ed. by Terence P. Moran, Neil Postman, and Charles Weingartner (New York: Bobbs-Merrill, Inc., 1968), a collection of fourteen essays, each describing the characteristics of a "specialized language," in Morris's sense of the term.

lines of research. From the perspective of systems theory, Morris's model is exceedingly deficient. In the first place, it is rigidly categorical and lineal, and pays no attention to the ways in which interactions occur. That is, Morris presents a static picture of language, not a dynamic one. In the second place, while Morris does offer a limited view of the subsystems within a larger system (language), he nowhere depicts the interactions of other important subsystems--gesture, for example. From the point of view of media ecology, Morris's model is useful in suggesting some lines of research--How, for example, is the language of politics different from the langauge of religion in its modes of signifying?--but it does not reflect most of the assumptions on which media ecology is based. Morris considers only superficially, for example, the ways in which the form of language affects, from a psychological point of view, the purposes of its users. Neither does he deal with the psychological effects of language forms on interpreters. In fact, Morris tends to separate the language user from his language in a way that most media ecologists would feel is a distortion of actual communication processes. Worst of all, Morris's model gives no attention to the relation of context to content. One might say that he is aiming at a kind of mathematical precision in his analysis of language, and in doing so, is leaving out everything that matters.

But not quite everything. As implied earlier, in some limited respects, Morris's model is useful. He does suggest, for example, a relationship between mode of communication and purpose. This is a relationship most media ecologists are interested in. Do modes of communication--i.e., the structural characteristics of codes and coding systems--

have singular effects on a total communication situation? Do different modes create unique environments? In what ways, if any, do particular modes of signifying advance or retard the purposes of a communicator? Moreover, Morris's conception of specialized language is quite useful in thinking about the metaphorical language of media. In what ways, for example, is the language of film different from the language of television? And how are these differences related to both their respective structures (modes of signification) and their dominant usages? Morris's model does, then, suggest some questions of interest to media ecology But in general, it is far too reductive and static for imaginative applications.

Two Linguistics Models:
Bloomfield, Fries, et. al., and Chomsky

As this is being written, there is no question that the major figure in the field of linguistics is Noam Chomsky. Beginning in 1957, with the publication of Syntactic Structures,[1] Chomsky's ideas on the subject of the theory of grammar have been the touchstone for most linguistic research. As John Lyons says in Noam Chomsky, "Chomsky's position not only is unique within linguistics at the present time, but

[1]Noam Chomsky, Syntactic Structures (The Hague: Mouton Press, 1957).

is probably unprecedented in the whole history of the subject. . . . At the age of forty-two, he speaks with unrivalled authority on all aspects of grammatical theory."[1] Yet, not surprisingly, Chomsky's model for the description of language is rarely, if ever, referred to in interdisciplinary studies in communication. More precisely, the details of his model are not referred to, no doubt because of their extreme complexity. This fact caused the investigator something of a problem, since to omit any consideration of Chomsky's conceptions of a linguistic model would be, in effect, to ignore the last fifteen years of linguistics. To resolve the problem, the investigator decided 1) to review the basic paradigm of structural linguistics, which is, in fact, the linguistic paradigm most frequently cited in the interdisciplinary literature, and 2) to review briefly the differences between the structural linguists' model and Chomsky's paradigm.

The structural linguistics model of language is, generally speaking, considered to have been developed in the 1920's and 1930's, principally by Leonard Bloomfield and Edward Sapir. To be sure, the model has clear antecedents in the work of Otto Jespersen and, before him, in the work of George Krapp. But it is widely agreed that not until the publication of Bloomfield's Language,[2] in 1933, was the basic model of scientific

[1]John Lyons, Noam Chomsky, Modern Masters Series, ed. by Frank Kermode (New York: Viking Press, 1970), p. 1.

[2]Leonard Bloomfield, Language (New York: Henry Holt & Company, 1933).

linguistics more or less formulated. More to the point, however, structural linguistics did not emerge fully as a paradigmatic science until the 1940's and 1950's, through the efforts of men like George Trager, Henry Lee Smith, Kenneth Pike, Bernard Bloch, and Charles Carpenter Fries.[1] It is their conception of how language might most profitably and scientifically be described, widely disseminated only after 1945, that has had the greatest impact on interdisciplinary studies in communication.

In essence, the structural linguistics model rests upon several assumptions: first, that language is speech, not writing; second, that the structure of language is a patterned message system which can be described independent of the content or semantic component of language; and third, that the structure of language is layered or hierarchical, proceeding from phonology (its sound system) to morphology (its word system) to syntax (its phrase and sentence system). The model assumes further that the central task of the linguistic scientist is to describe as thoroughly as possible what the structure of a particular language is--that is, what are its basic sound units, word units, and phrase and sentence units, and how these units interact. It must be stressed here that structural linguists have not been concerned to explain how the structure of language comes to be learned or even produced (in a psychological sense)

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[1] See, for example, George L. Trager and Henry Lee Smith, Outline of English Structure (Norman, Okla.: University of Oklahoma Press, 1951); Kenneth L. Pike, The Intonation of American English (Ann Arbor, Mich.: University of Michigan Press, 1946); Bernard Bloch and George L. Trager, Outline of Linguistic Analysis (Baltimore: Linguistic Society of America, 1946); and Charles Carpenter Fries, The Structure of English (New York: Harcourt, Brace & World, 1952).

by the speakers of the language. Their aim is precise description, and their definition of a grammar of a language is a more or less complete description of its structural signals.

Thus, one might say that the structural linguistics model is basically a guide to doing research. It directs one's attention to a particular aspect of a communication situation, and it provides a lexicon and a classification system for analyzing and describing that aspect. In this regard, structural linguistics contributes a number of important ideas to to media ecology and is consistent, in certain limited ways, with systems principles.

To consider the latter first, structural linguistics does make a distinction between a large system (language) and the various subsystems that comprise it. For example, linguistic structure is conceived as a subsystem of language, and beyond that, phonology, morphology, and syntax are subsystems of linguistic structure. Nor does the hierarchy of systems end there: within each of the major subsystems linguists identify, they identify sub-subsystems, as well. Phonology, for example, is described in the structural linguistics model as the product of the two subsystems, phonetics and phonemics. Of course, structural linguistics is deficient from a systems perspective in that it does not relate language to any larger system--for example, to psychology or to culture. In fact, structural linguists have insisted, in general, on treating language as an entity in itself--almost an object--that exists independent of any particular context. Thus, in the structural linguistics model, grammatical meaning is distinct from semantic meaning, and the latter is relevant only insofar as it contributes to an understanding of grammatical meaning. For all practical purposes, then, the subsystem of semantic meaning in language is disregarded by structural linguists.

On the other hand, the structural linguistics model has been quite adequate in demonstrating how certain subsystems of language interact, and in providing a language for describing such interaction. For example, structural linguists developed the concept of suprasegmental phonemes, which can be defined as structurally significant aspects of pitch, stress, and juncture (pause) which act to modify in significant ways the functions of larger units of speech. Suprasegmental phonemes interact with all other layers of structure so that, depending on how pitch, stress, and juncture are used, we can derive several different meanings from the separate words, and the phrase as a whole, light house keeper, for example. Like systems theory, then, structural linguistics takes as a basic principle that the whole is greater than the sum of its parts. In this respect, and insofar as it also takes as axiomatic the principle that it is the organizing relations among parts that gives language its significant characteristics, the structural linguistics model has much to recommend it, from a systems point of view.

As a set of research guidelines, moreover, the structural linguistics model is quite useful to media ecologists. Ray Birdwhistell, for example, has borrowed heavily from the methodology of structural linguistics to develop the field known as kinesics, or the study of nonverbal communication,[1]

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[1]Ray L. Birdwhistell, Kinesics and Context (Philadelphia: University of Pennsylvania Press, 1970).

and theoretically, at least, there is no bar to employing the structural linguistics methodology in the study of all the codes media ecologists are interested in. McLuhan, Carpenter, and other media ecologists, in fact, emphasize the significance and the potential of the linguists' model for the study of media environments by their frequent use of such phrases as "the grammar of film."[1] In fact, one might say that, in a certain sense, the basic postulate of structural linguistics is that "the medium is the message," a principle familar enough to all media ecologists. The applications of the structural linguistics model are not confined, moreover, to the study of codes, but may be extended to the study of larger environments as well--for example, the classroom, the courtroom, or the beauty parlor. What structural linguistics says, in effect, to media ecologists is that by keeping one's attention focused on structure, and by identifying the layered subsystems in a structure, one can discover important knowledge about the communication process, no matter what the content of the process in a particular setting may be. Moreover, the linguists add, only by confining oneself to structural description can scientifically adequate preceision be achieved.

All of this notwithstanding, it is clear that structural linguistics offers an essentially reductionist and atomistic model. It tries to isolate the discrete components of speech not only by removing speech from the contexts which motivate it, but by following a method of classification which, by its very nature, emphasizes the parts rather than the whole of language. Structural linguistics, one might say, is con-

[1]See, for example, Edmund Carpenter and Marshall McLuhan, eds., Explorations in Communication (Boston: Beacon Press, 1960), pp. ix-xii.

cerned with the structure of a code, but not with the structure of the users of the code or of the situations which affect the users. It makes no systematic effort to show how structures are generated, or how the spontaneous, creative flow of speech is produced. Its main effort is centered on taking, as it were, a snapshot of language, breaking it down into its component parts, and suggesting how those parts might be related. In short, the structural linguistics model deals exclusively with what Grinker calls the "space form" of the linguistic system, not its dynamic properties.[1] It is this deficiency of structural linguistics that Noam Chomsky has tried to correct.

In "Three Models for the Description of Language," Chomsky discusses what he calls Finite State Markov Processes (as model number one), Phrase-Structure/Immediate Constituent Analysis (as model number two), and Generative-Transformational Grammar, the model for the analysis and description of language which he proposes.[2] In Chomsky's model, the task of the grammarian is not merely to describe the sentences produced by speakers of a language, but also to explain how such sentences are produced. What is needed, Chomsky asserts, is a theory of grammar--an abstract set of statements (i.e., rules)--which explains how an infinite number of sentences can be produced from a limited number of basic structures. In Chomsky's own words, linguists who share his paradigm

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[1]See supra, p. 91.

[2]Noam Chomsky, "Three Models for the Description of Language," in Communication and Culture, ed. by Alfred G. Smith (New York: Holt, Rinehart, and Winston, Inc., 1966), pp. 140-152.

"picture a language as having a small, possibly finite kernel of basic sentences . . . along with a set of transformations which can be applied to kernel sentences or to earlier transforms to produce new and more complicated sentences from elementary components."[1]

The difficulty with Chomsky's model is that, in developing it, he uses language of such complexity that only professional linguists have been able to cope with it. However, it is fairly clear that Chomsky's model differs strikingly from the model of structural linguistics. It is, as its name suggests, a generative model; that is, it focuses on the organic and dynamic characteristics of language. Whereas structural linguistics depicts language as a sequence of interconnected boxes, Chomsky conceives of it as a biological cell capable of enlarging and transforming itself in a number of possible, but finite, directions. In this sense, Chomsky's model coincides quite congenially with the perspectives of systems theory. Moreover, Chomsky postulates, unlike the structural linguists, that there exists a universal grammar--that is, a genetically originating set of kernels and rules of transformation that underlies all human languages. Since general systems theorists have themselves postulated virtually the same theory for all natural systems, there ought to be much to be gained from Chomsky's model.

One of the clearest ways in which Chomsky's conception of language coincides with the perspectives of systems theory is in Chomsky's in-

[1]<u>Ibid.</u>, p. 152.

sistence that he is speculating not so much on a theory of language, but on a theory of mind. "For Chomsky believes," writes Lyons, "that the structure of language is determined by the structure of the human mind."[1] In other words, for Chomsky, language is a subsystem of a larger system. One of the ways in which he has tried to conceptualize this idea is by making a distinction between linguistic competence and linguistic performance. By competence, Chomsky means one's innate knowledge of the structure of language (including its kernels and rules of transformation), which structure is a function of the structure of mind. By performance, he means one's actual production of speech in specific situations. Performance, in this context, can never equal competence; one always "knows" more about language than one can display. By making this point, Chomsky has, in effect, created a model which can explain why people can spontaneously produce sentences they have never heard before. Such a model represents a sharp distinction from the structural linguistics model in the following respect: Insofar as the structural linguistics model had anything to suggest about how language is learned and how new sentences are produced, it favors an input-output conception. That is, one hears language spoken by others and then, at appropriate times, simply repeats what one has heard. Chomsky, in effect, rejects an input-output conception and replaces it with a generator metaphor. In his model, in short, language is behavior through which the speaker acts upon his environment, rather than re-

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[1]Lyons, Noam Chomsky, p. 8.

sponding to it. In this view, Chomsky is again in agreement with systems theorists in their conception of organismic behavior as primarily active, rather than reactive.

Chomsky's model is highly suggestive to the media ecologist. His distinction between competence and performance, for example, can be used as a model for describing a number of communication situations. In fact, Erving Goffman to some extent employs this distinction by implication in his dramaturgical model for describing everyday human interactions. Using Chomsky's model as a base, one might further postulate that every social system is, first of all, structured along lines that are compatible with the structure of the mind, and, second, characterized by rules which are "known" to all the participants in the system. However, any individual's performance is always unique and, within limits, spontaneous. When a performance goes beyond the limits of the rules of the system, one may assume, to use Chomsky's term, that we have an "ungrammatical" performance, and we might profitably look for evidence of psycho-pathology.

In any event, the clash between the structural linguistics model and Chomsky's paradigm has fortuitously added a number of interesting possibilities to the inquires of media ecologists.

A Perceptual Model: Ames and Cantril

Although there are several approaches to the study of human perception, the framework provided by Adelbert Ames, Jr., underlies most of the major contributions to the study of the role of perception in human communication, as represented, for example, in the work of Hadley Cantril, W. H. Ittelson, and John Dewey.[1] As Dewey himself wrote, in his first published letter to Ames (in December, 1946),

> It would not be possible for me to overstate my judgment as to the importance of your demonstrations with respect to visual perception nor the importance of their being widely known. While the demonstrations themselves are in the field of visual perception, they bear upon the entire scope of psychological theory and upon all practical applications of psychological knowledge, beginning with education.[2]

The demonstrations referred to by Dewey were begun by Ames in 1938, and were designed to study the nature of perception. Ames's perception "laboratory" included oddly-shaped rooms, chairs, windows, and other objects which seemed to "distort" reality when perceived by ordinary people in ordinary situations. In point of fact, the objects and the

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[1]Ames's work is best represented in The Morning Notes of Adelbert Ames, Jr., ed. and with a preface by Hadley Cantril (New Brunswick, N.J.: Rutgers University Press, 1960), and is further developed in Hadley Cantril, The "Why" of Man's Experience (New York: The MacMillan Company, 1950); in W. H. Ittelson and Hadley Cantril, Perception: A Transactional Approach (Garden City, N.Y.: Doubleday & Company, Inc., 1954); in John Dewey and Arthur F. Bentley, Knowing and the Known (Boston: Beacon Press, 1949), and in Earl Kelley, Education for What is Real, with a preface by John Dewey (New York: Harper & Brothers, 1947).

[2]Dewey, in Cantril, ed., The Morning Notes, p. 171.

field surrounding them were carefully designed to create an effect of "optical illusion." Ames believed that from the "illusions" he might learn something of the way in which all perceptions come to us (or from us, as it turned out). From his studies, Ames came to six conclusions:

1. We do not get our perceptions from the "things" around us. Our perceptions come from within us.

2. What we perceive is largely a function of our previous experiences, our assumptions, and our purposes.

3. We are unlikely to alter our perceptions until and unless we are frustrated in our attempts to do something based on them.

4. Since our perceptions come from within us and are based on our past experience, each individual will perceive what is "out there" in a unique way.

5. Perception is, to a much greater extent than previously imagined, a function of the linguistic categories available to the perceiver.

6. The meaning of perception is how it causes the perceiver to act.[1]

Dewey was especially interested in Ames's work because he believed, as he indicated in the Preface to Education for What is Real, that Ames had provided empirical evidence for the "transactional psychology" he and Arthur Bentley had formulated in Knowing and the Known. Dewey and Bentley used the term "transaction" to minimize the mechanistic oversimplification of the term "interaction," and to suggest the mutually simultaneous,

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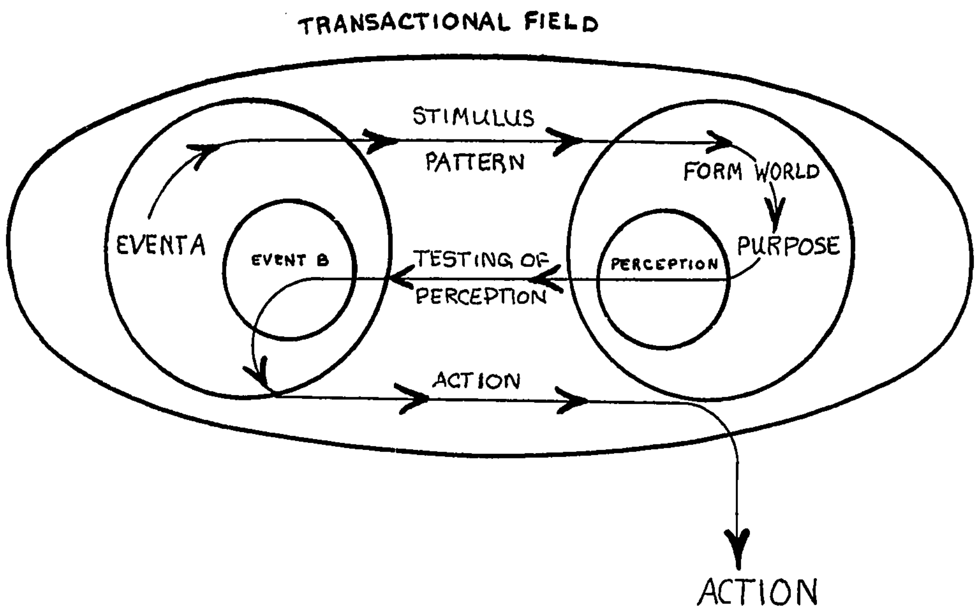
[1]This summary of Ames's conclusions was derived primarily from Cantril, The Morning Notes and The Why of Man's Experience, and from Kelley, Education for What is Real.

highly complex, and continuous "bargaining" process between what is inside and outside our skins.

In order to indicate the nature of that process, Ames produced, in 1949, a model of the communication process which reflects his findings on human perceptual behavior. That model, as it appears in The Morning Notes, is reproduced in Figure 21.

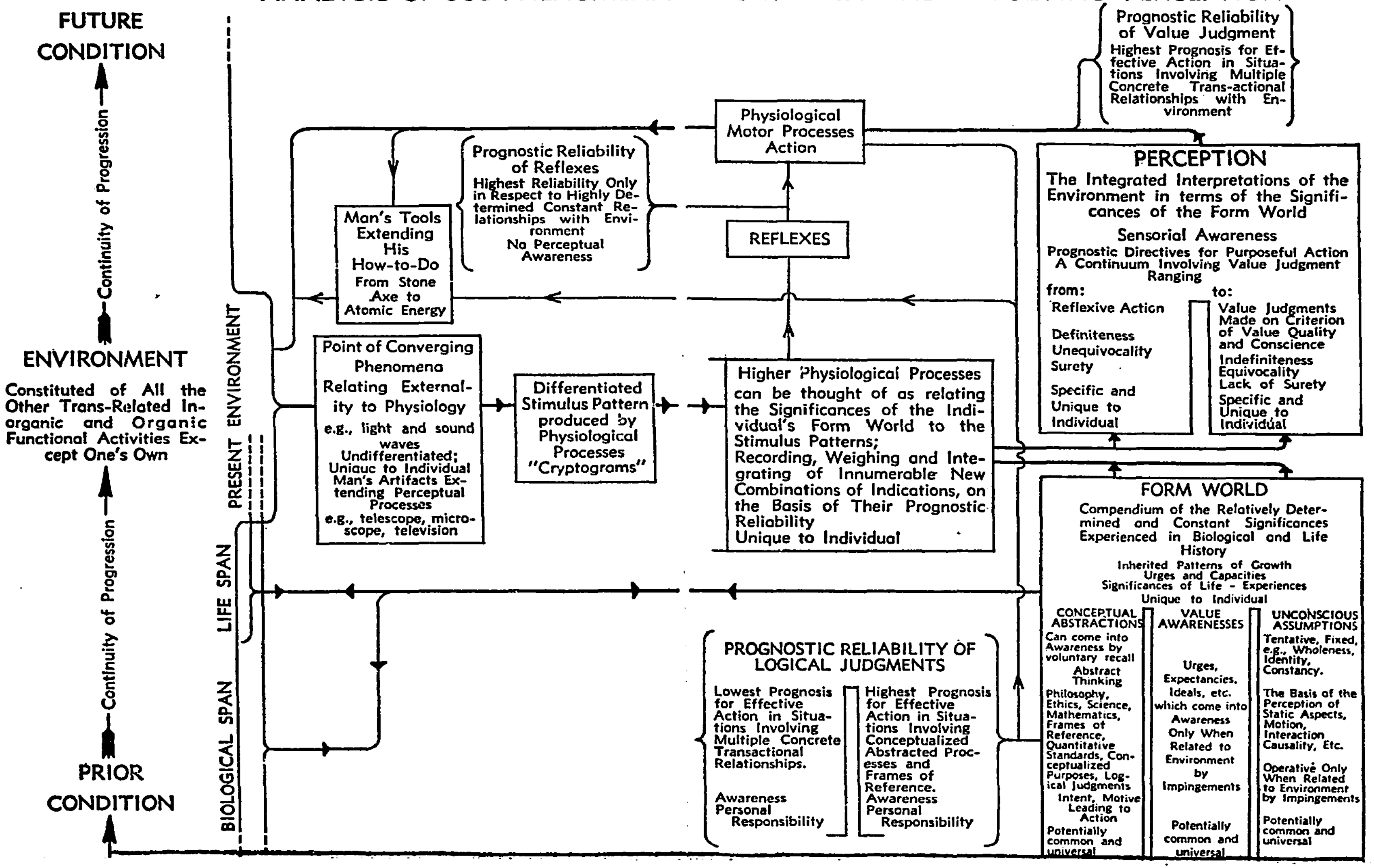
So far as the investigator was able to determine, Ames's model is rarely represented in its original form in the literature of interdisciplinary studies in communication, or even in the literature of psychology, perhaps because of its complexity. However, from a careful analysis of what aspects of the model are most often stressed in such literature, it was possible to construct a simplified representation of Ames's basic conception of the perceiving-behaving process. That representation is provided in Figure 20.



A Simplified Version of Ames's Model

Figure 20

TRANSACTION OF LIVING
ANALYSIS OF SUB-PHENOMENA INVOLVED IN AND INVOLVING PERCEPTION



AMES: Transaction of Living
Figure 21

Any explication of either Ames's original model or the adaptation of it provided in Figure 20 must begin with the term form world. By form world, Ames means the conceptual abstractions, values, and unconscious assumptions which comprise one's "mind," and which are derived from the individual's experiences and biological structure. Without such a form world, according to Ames, we could assign no meaning to what we are looking at. The form world is, moreover, governed in a crucial sense by the purposes of the perceiver. Without purpose, in Ames's view, there can be no stable form world, and, therefore, no meaningful interpretetion of what is "out there."

A unique feature of Ames's model, as depicted in Figure 20, is represented by the elliptical line that completely encloses the perceiver and his environment (the transactional field). This device is intended to stress Ames's point that "there cannot exist any so-called 'objective world,' or any 'otherness-out-there,' apart from the significance to unique persons operating in their unique transactional situations."[1] Ames does not deny that there is an "objective world"; he asserts only that it is unknowable and without meaning apart from a perceiver, who brings to it a set of expectations which give form (in a word, meaning) to what is "out there."

What happens, then, in the perceiving process may be described in

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[1]Ames, in Cantril, ed., The Morning Notes, p. 81.

the following way: The perceiver brings to any transaction with "reality" a set of assumptions and purposes which will give meaning (i.e., where it is, what it is, how it is, etc.) to the stimulus pattern (Event A in Figure 20) which confronts him. While creating meanings out of the stimulus pattern, the perceiver almost simultaneously tests his meanings against the pereceived stimulus pattern (Event B). "Almost simultaneously" is used here to suggest that one cannot look back at the "same" event which originally stimulated one's perception. Therefore, one must verify one's perception against a new stimulus pattern--new because of the infinitismal passage of time, and because of the interposition of an initial perception between Event A and Event B. Part of the form world of most perceivers, however, is the assumption of stability and continuity. One assumes, therefore, that Event B is sufficiently similar to Event A so that Event B can be used as a source of verification for one's perceptions of Event A. The ultimate verification of the validity of one's perception, however, is obtained through acting on the basis of the perception. If one's action appears to satisfy one's purpose, then it is assumed that the perception is valid.

Ames's conception of the process of perception is, in effect, a conception of the process by which we communicate with the world outside our skins, and vice-versa. One of his major insights, of course, is that the usual distinction between "inside" and "outside" is incorrectly stated. He maintains that what is usually conceived of as "outside" is in fact created by what is "inside," and that, at the same time, what is "inside" is built up from what is "outside." In short, the distinction between "outside" and "inside" is, in Ames's view, simply a linguistic distinction, and not very useful for representing the way things, in fact, are.

The most useful idea Ames's model contributes to media ecology is his conception that the perceiver plays an active, not a passive role in the communication process. (In this conception, Ames is, of course, in agreement with the central systems principle that organismic behavior is primarily active and creative, rather than passive and merely respondent.) Ames rejects the idea that the meaning of something is in the something; rather, meaning is assigned to something by the perceiver. The most obvious implication of this for the study of the communication process is that it shifts the focus of inquiry from the question, What is being communicated?, to the question, What am I assuming is being communicated? Moreover, Ames's model suggests where we might look to discover the causes of misunderstanding--namely, to the form world, or as Cantril calls it, the assumptive world, which generates the perceptions of each of us.

In spite of the seeming comprehensiveness of Ames's original model (Figure 21), there are several important weaknesses in it from both a media ecology and a systems point of view. While Ames does indicate that the linguistic subsystem is part of the material out of which we build our assumptive world, for example, he suggests no role for other media. In fact, he does not take into serious account the special forms in which a stimulus pattern can be transmitted. Media ecologists would, of course, be particularly interested in how our perceptions are both structured and altered by the structure of the media that "massage" us, but on this matter, Ames has little to say. In addition, his model is almost exclusively concerned with the intrapersonal psychological process, and does not stress the ways in which perceptions may be influenced by social conditioning or by other, larger systems within which individuals function. In short, the Ames model would appear to be most useful in the study of intrapersonal and interpersonal communication and, more specifically, of the questions, Why do people "understand" each other, and why do they not? Why am I having difficulty in acting appropriately, and why am I not?

A Transactional Model: Berne and Harris

The communication model associated with Transactional Analysis in psychotherapy has its roots in the work of Harry Stack Sullivan, who is credited with having introduced to psychology the concepts of "interpersonal relations" and of "transactions" as the basic units of social intercourse.[1] The model was formalized by Eric Berne,[2] and has achieved its current popularity in interdisciplinary studies largely through the efforts of Thomas A. Harris, whose book I'm OK--You're OK presents the model in its clearest and most concise form.

The transactional model consists of several parts, some represented verbally only, some in diagrammatic form. It begins with the generalization that all human communication is primarily social (i.e., interpersonal or transactional) in nature. In this view (as in Ruesch and Bateson's) intrapersonal communication (i.e., perception, thought, attitudes, value, etc.) is a special case of interpersonal communication, in which

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[1]Thomas A. Harris, I'm OK--You're OK: A Practical Guide to Transactional Analysis (New York: Harper & Row, 1969), p. 44.

[2]Eric Berne, Transactional Analysis in Psychotherapy (New York: Grove Press, 1961).

an imaginary entity made up of condensed past experiences represents within the individual the missing "other" of the interpersonal situation.[1]

In the transactional view, the basic patterns of an individual's intrapersonal and interpersonal communication behavior are established very early in life. As Sullivan explains,

> The child lacks the equipment and experience necessary to form an accurate picture of himself, so his only guide is the reactions of others to him. There is very little cause for him to question these appraisals, and in any case he is far too helpless to challenge them or to rebel against them. He passively accepts the judgments, which are communicated empathetically at first, and by words, gestures, and deeds in this period . . . thus the self-attitudes learned early in life are carried forever by the individual, with some allowance for the influence of extraordinary environmental circumstances and modification through later experiences.[2]

According to Berne and Harris, the most significant transactions in an individual's life (in terms of establishing patterns for future communication behavior) take place in infancy, between birth and roughly the third year, and are accomplished largely through non-verbal media--primarily, stroking. As Harris explains,

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[1]This concept has its original and perhaps most concise expression in the theory of the "generalized other" advanced by George H. Mead in 1934. (See George H. Mead, Mind, Self, and Society /Chicago: University of Chicago Press, 1934/, pp. 152-164.

[2]Harry Stack Sullivan, The Interpersonal Theory of Psychiatry (New York: W. W. Norton & Company, 1953), cited by G. S. Blum, Psychoanalytic Theories of Personality (New York: McGraw-Hill Book Company, 1953), pp. 73-74.

> . . . at biological birth, the little individual, within the brief span of a few hours, is pushed out into a state of catastrophic contrast /with the womb/ in which he is exposed to foreign and doubtless terrifying extremes of cold, roughness, pressure, noise, nonsupport, brightness, separateness, and abandonment. The infant is, for a short time, cut off, apart, separate, unrelated . . . flooded with overwhelming, unpleasant stimulations, and the feelings resulting in the child are, according to Freud, the model for all later anxiety.
>
> Within moments the infant is introduced to a rescuer, another human being who picks him up, wraps him in warm coverings, supports him, and begins the comforting act of "stroking." This is the point of Psychological Birth. This is the first incoming data that life "out there" isn't all bad. It is a reconciliation, a reinstatement of closeness. It turns on his will to live. Stroking, or repetitious bodily contact, is essential to his survival. Without it he will die, if not physcially, then psychologically.[1]

In infancy, then, physical strokes are the basic units of the transactions through which the child defines "self" and "other." As the child grows older, however,

> He learns to do with more subtle forms of handling, until the merest nod of recognition may serve the purpose to some extent. . . . The result is a partial transformation of the infantile stimulus-hunger into something which may be termed recognition-hunger. . . . Thus, by an extension of meaning, "stroking" may be employed to denote any act implying recognition of another's presence. Hence, a stroke may be used as the fundamental unit of social action. An exchange of strokes constitutes a transaction, which is the unit of social intercourse.[2]

The first part of the transactional model, then, has to do with the analysis of human communication in reference to the concept of strokes, and may be summarized as follows: 1) People need stroking--in infancy, physical stroking, and in adulthood, symbolic forms of stroking--

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[1]Harris, I'm OK--You're OK, pp. 40-41.

[2]Eric Berne, Games People Play: The Psychology of Human Relationships (New York: Grove Press, Inc., 1967), p. 15.

to survive; without it, "their spinal cords shrivel" (literally or metaphorically), and they die (physically or psychologically); 2) the primary motivation in human communication, therefore, is to obtain strokes (physical or psychological reassurances); 3) to get strokes, one must give strokes; 4) every human transaction, therefore, consists of an exchange of strokes; and 5) transactions can be analyzed in terms of the number and intensity of strokes exchanged, and communication problems can be explained, in part, as the consequences of disorders or anomalies in the stroking process.

One of the strengths of the "stroking" model of communication is that it helps to explain the structure and function of such common transactions as what Berne calls "American greeting rituals."[1] In terms of the transactional model, a ritual may be defined as a culturally institutionalized series of transactions whose sole purpose is to provide its participants with a "guaranteed minimum income" of strokes in almost any context. "Hi--Hi," for example, is a two-stroke transaction with no function except to insure each of its participants at least one stroke each time it is initiated. And the beauty of the "Hi--Hi" ritual is that it can be conducted in almost every context in American culture, between total strangers as well as between acquaintances, whenever strokes are needed.

While greeting rituals may seem on the surface to be casual and

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[1] Ibid., p. 37.

informal, Berne points out, they are in fact, governed by quite rigid rules. Take, for instance, the case of Mr. A and Mr. B (in an example provided by Berne): Based on careful intuitive computations, Mr. A and Mr. B figure that they owe each other exactly one stroke ("Hi") at each meeting, and not oftener than once a day. This computation, Berne notes, holds not only for short intervals, but over periods of weeks and even months. Suppose, for example, that Mr. A goes on a month's vacation. The day after he returns, he encounters Mr. B as usual. If on this occasion Mr. B says simply "Hi" and no more, Mr. A will be offended; in Berne's terms, "his spinal cord will shrivel slightly." By his calculations, he and Mr. B owe each other about thirty strokes--the month's accumulation. These can be compressed, Berne notes, into a few transactions, if the strokes exchanged are intense enough. Mr. B's part, Berne suggests, might go something like this (where each unit of emphasis, intensity, or interest is equivalent to one stroke):

1B: "Hi!" (1 unit)

2B: "Haven't seen you around lately." (2 units)

3B: "Oh, <u>have</u> you! Where did you go? (5 units)

4B: "<u>Say, that's interesting</u>! How was it? (7 units)

5B: "Well, you're sure looking fine." (4 units) "Did your family go along? (4 units)

6B: "Well, glad to see you back." (4 units)

7B: "So long." (1 unit)

This gives Mr. B a total of 28 units, and the remainder can be supplied the following day. In any event, as Berne points out, the account is now, for all practical purposes, squared, and within two days

Mr. A and Mr. B will be back at their two-stroke exchange, Hi--Hi.[1]

The "stroking" element of the transactional model serves not only analytical and explanatory functions, but a heuristic function as well. One of the interesting questions to which it leads has to do with communication systems in different cultures. American greeting rituals, for example, usually range from two- to twelve-stroke transactions, while such rituals in other cultures (Oriental cultures, for example) may run to two hundred strokes or more. Are the people of "high-stroke" cultures more self-confident, less anxious, than the people of "low-stroke" cultures? What is the effect on a culture of significant changes in the "stroke content" of its rituals? Does the frequent refusal of the young to "play those games" in our own culture promote increased honesty, intimacy, "good feelings," as they would claim, or does it lead to greater insecurity, anxiety, alienation?

Despite its utility for explaining some communication behaviors, however, the model thus far leaves many questions unanswered. Different people quite obviously have different needs for stroking, and respond differently to the strokes they receive. What accounts for such differences?

To answer that question, Berne and Harris introduce the second major element in their model: the concept of a "life position." On the basis of his own experiences of himself and his transactions (through stroking) with others, the child arrives, by the end of his second year, at one of

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[1] Ibid., p. 38.

three preverbal conclusions about the way things are:

I'M NOT OK--YOU'RE OK

I'M NOT OK--YOU'RE NOT OK

I'M OK--YOU'RE NOT OK[1]

The first position, I'M NOT OK--YOU'RE OK, is, according to Berne and Harris, the conclusion all normally-handled children arrive at early in life. The child experiences himself as NOT OK simply because he is subject from birth to unpleasant stimuli quite beyond his power to understand or control--hunger, extremes of temperature, nonsupport, sudden lights and sounds, and so on. The normal child, however, also experiences OK-ness--the warmth, comfort, support, security his parents provide by holding, feeding, and stroking him--and by the end of his second year he realizes that the source of the stroking is "out there." So YOU'RE OK.[2]

The second position, I'M NOT OK--YOU'RE NOT OK, is the conclusion of those children who, for one reason or another, experience little or no stroking early in life. An extreme case is the autistic child, who apparently because of physiological impairment, has little or no _sensation_ of the stroking he receives. Hence he has no transactions with others early in infancy, and is never psychologically or socially born. More frequently, children who conclude I'M NOT OK--YOU'RE NOT OK have simply been neglected. For them, there is no source of rescue "out

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[1]Harris, _I'm OK--You're OK_, p. 43.

[2]_Ibid._, pp. 43-46.

there." As Harris points out, I'M NOT OK--YOU'RE NOT OK is a hopeless position, and the child forced to adopt it has little chance of reaching a normal adulthood.[1]

The third position of infancy, I'M OK--YOU'RE NOT OK, is the conclusion reached by children alternately exposed to gross physical abuse and neglected. All such children who survive, experience not only extreme pain in their contacts with others, but periods of healing during which, left by themselves, they experience a sense of comfort--if only by comparison with the pain they experience at the hands of others. Such children find in themselves, then, the only source of comfort they know, and consequently conclude I'M OK--YOU'RE NOT OK. The position is a life-sustaining one but has tragic consequences for both the child and society: I'M OK--YOU'RE NOT OK is the basic position of the psycho-sociopath.[2]

The significance of the early life-positions is that, once established, they act as screens through which all new experience is filtered. The child in either of the two YOU'RE NOT OK positions is almost impossible to reach after the age of two, since, in Harris's words, "a stroke is only as good as the stroker,"[3] and from the child's point of view, there are no OK people out there. Consequently, he has no motivation to engage in further transactions.[4]

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[1]Ibid., pp. 46-48.

[2]Ibid., pp. 48-50.

[3]Ibid., p. 49.

[4]Ibid., pp. 47, 49.

The normally-handled infant, on the other hand, is in a basically hopeful position. From his point of view, as he enters the third year of life, he's NOT OK, but there are "others" out there who are, and whose strokes make his life bearable--even pleasant. The question for the normal child, then, is "What must I do to gain their strokes, or their approval?"[1] Now, it is important to note that, by the time he is two years old, three things have happened in the child that permit him to formulate such a question (preconsciously, of course). The first is that he has made a rude distinction between feelings that originate from somewhere outside him ("other"). In the language of transactional analysis, the first set of feelings is called technically the archaeopsychic ego, and the second set the exteropsychic ego.[2] Second, he has developed a rudimentary grasp of the notion of causality--that one set of feelings is somehow connected with the other. And third, he has begun to acquire language--a tool which allows him to begin to sort, store, and communicate about experiences. Together, the development of the concept of causality and the acquisition of language promote the development in the infant of what is technically called the neopsychic ego.[3] Colloquially, the archaeopsychic ego or ego state is called, in transactional analysis, the Child; the exteropsychic ego or ego state is called the Parent; and the neopsychic ego or ego state is called the Adult.[4] The Child, generally,

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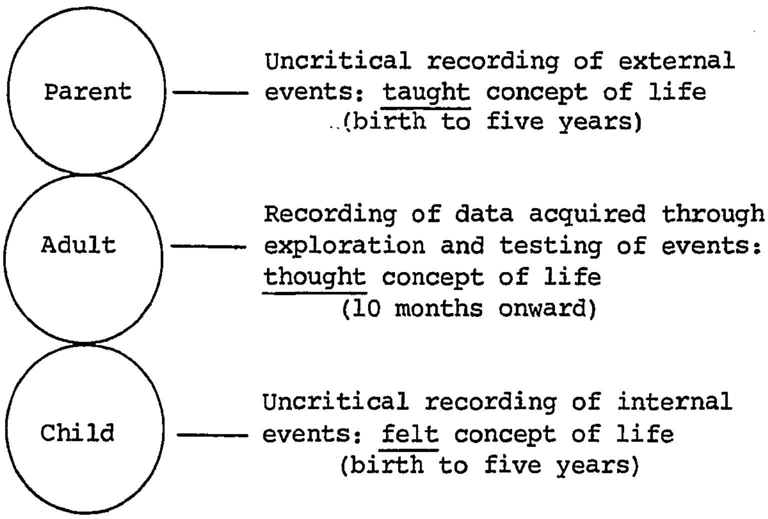
[1] Ibid., p. 45.

[2] Berne, Games People Play, p. 23.

[3] Ibid.

[4] Ibid.

is the repository of the most primitive feelings of the infant (e.g., insecurity, frustration, and rage, as well as contentment and joy); the Parent is the repository of feelings (and statements) about oneself and the world derived from early transactions with others; and the Adult is the repository of data acquired through the exploration and testing of the environment which begins, in infancy, at roughly ten months--when the child acquires some degree of mobility.[1] Thus, the structure of personality, as conceived in the transactional model, is represented in Figure 22.



Berne and Harris: The Structure of Personality[2]

Figure 22

Three points must be made about this model. The first is that, in transactional analysis, Parent, Adult, and Child are not _concepts_

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[1]Harris, _I'm OK--You're OK_, pp. 24-28.

[2]_Ibid._, p. 29.

like the Superego, Ego, and Id of Freudian psychology. As the term "recordings" suggests, they are phenomenological realities--sets of data stored in the brain.[1] Second, the content of the Parent and Child is stored unconsciously and, as Harris puts it, without editing--largely because "the situation of the child, his dependency, and his inability to construct meanings with words, makes it impossible for him to modify, correct, or explain."[2] And third, no matter how "well-adjusted" someone is, his Parent and Child are always operative in his adult life. As Harris puts it, "we can never erase the early recordings."[3] We can, however, choose to turn them off.

This brings us to the function of the Adult. The Adult acquires and processes data from three sources: events in the external world, messages from the Parent, and messages from the Child. One of its primary functions is to examine the data in the Parent, to see whether or not it is true and still appropriate today, and to accept or reject it; and to examine the Child to see whether or not the feelings there are appropriate to the present or are archaic and in response to archaic Parent data. The goal of the Adult is not to do away with the Parent and Child, but to examine these bodies of data, to select what is appropriate and useful, and to reject what is not.[4]

To return now to the literal child; by the age of three (assuming

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[1]Berne, Transactional Analysis in Psychotherapy, p. 24.

[2]Harris, I'm OK--You're OK, p. 19.

[3]Ibid., p. 32.

[4]Ibid., p. 30.

normal development) he has both the mobility and language he needs to develop a well-functioning, reality-testing, Parent- and Child-monitoring Adult. If he receives consistent stroking for his Adult behaviors (which include questioning of parental directives as well as extensive experimentation with both objects and events in his environment and the expression of his Child feelings), he will eventually reach a point where his Adult is well established enough to monitor and control his NOT OK feelings. The well developed Adult ego, in short, permits one to move from the unconscious and preverbal early life position I'M NOT OK--YOU'RE OK to the conscious decision I'M OK--YOU'RE OK. That decision, Harris and Berne stress, does not erase the NOT OK feelings recorded in the Child, but reflects both the conviction that the Adult can monitor those feelings and a commitment that it shall. I'M OK--YOU'RE OK is the conscious life position of the self-directing, reality-oriented, autonomous adult.[1]

Unfortunately, however, most children do not move naturally from I'M NOT OK to I'M OK. The developing Adult in the three- to five-year-old is quite fragile and is easily "contaminated" or decommissioned altogether by the overly protective, overly punitive, or overly permissive parent. The overly protective parent not only severely restricts the child's reality-testing, but communicates to him over and again the message "It's dangerous out there," thus at the same time impairing the child's Adult

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[1]Ibid., pp. 50-53.

and increasing his NOT OK feelings. The punitive parent accomplishes the same results by overriding the child's natural curiosity by fear. And the overly permissive parent lets the child experiment with the environment and his own feelings beyond the limits of physical and emotional safety, until the painful consequences of his experiences force the child to withdraw from further reality-testing, more convinced than ever that he's NOT OK.[1]

The child (or grown-up) with a weakened or decommissioned Adult cannot move to an I'M OK position; consequently, he is forever dependent on others for the stroking which can allay his NOT OK feelings. To get it, he adopts one of two <u>life scripts</u>, the first written by the Child, the second written by the Parent. The first calls for the acting out of Child feelings in a way so provocative that others are compelled to pay attention, and by attending provide strokes, even if they are negative. The second calls for acting out behaviors dictated by the Parent (YOU CAN BE OK, <u>IF</u>). The Parent-directed person seeks strokes either by being the Child his parents told him to be (e.g., dutiful, compliant, obedient) or by acting out in his own life the scripts his parents followed (i.e., he says what they said, does what they did). No matter which script he follows, however, the person with an incapacitated Adult finds his NOT OK position constantly confirmed.[2]

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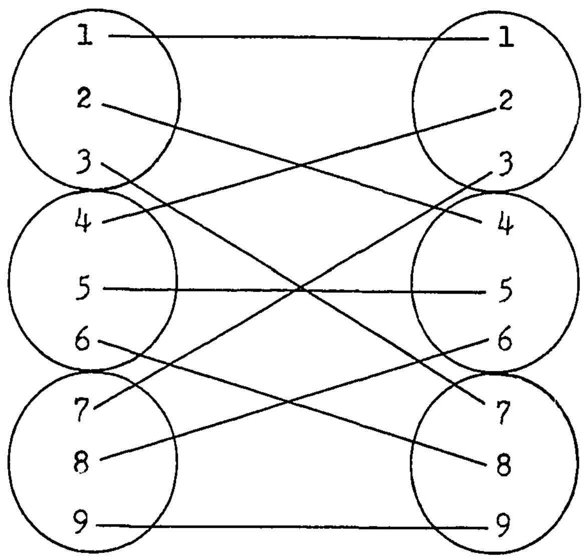
[1] <u>Ibid</u>., p. 35.

[2] <u>Ibid</u>., pp. 45-46.

The significance of life scripts is that, unless they are identified and consciously changed, they structure all the transactions in which the person engages. To help people identify their own life scripts and analyze their transactions, Berne and Harris introduce the final element in their model: a set of diagrams for the structural analysis of interpersonal communications. The first of these, which Berne calls "a relationship diagram," is represented in Figure 23.



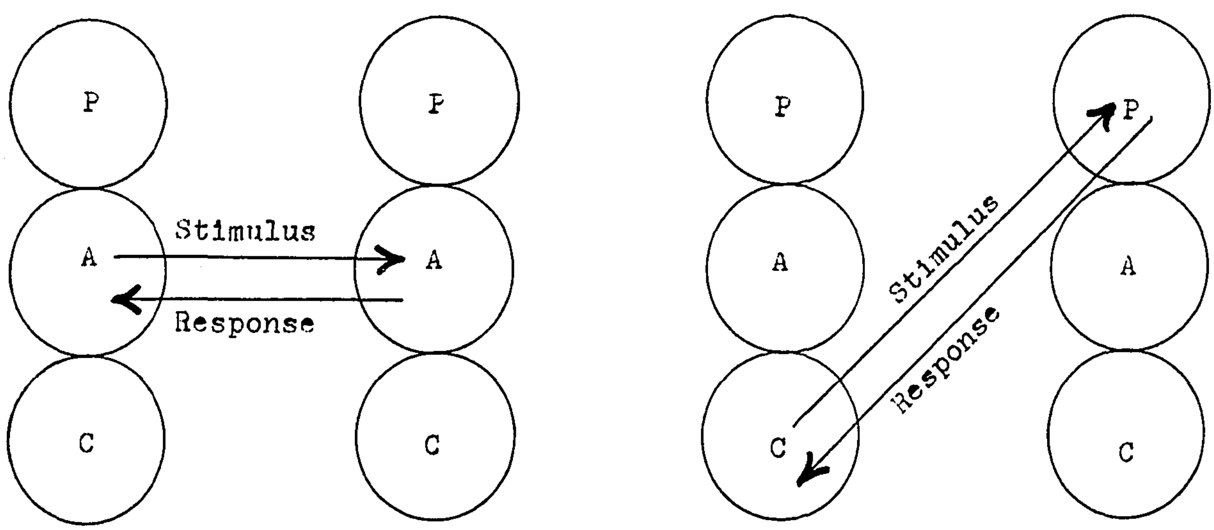
Berne and Harris: An Interpersonal Relationship Diagram[1]

Figure 23

[1]Berne, Games People Play, p. 31.

The diagram in Figure 23 represents the following points: 1) every person has three different ego states--Parent, Adult and Child; 2) in any given transaction, the transactional stimulus may originate in either the Parent, Adult, or Child of Person A and may be directed at either the Parent, Adult or Child of Person B (thus there are nine possible vectors for transactional stimuli); 3) in any given transaction, the transactional response may originate in either the Parent, Adult, or Child of Person B, and may be directed at the Parent, Adult or Child of Person A (thus there are nine possible vectors for transactional responses).

According to Berne, transactions may be classified, first, as either complementary or crossed. In complementary transactions, the vectors for the transactional stimulus and the transactional response run parallel to one another, as in the two diagrams in Figure 24.



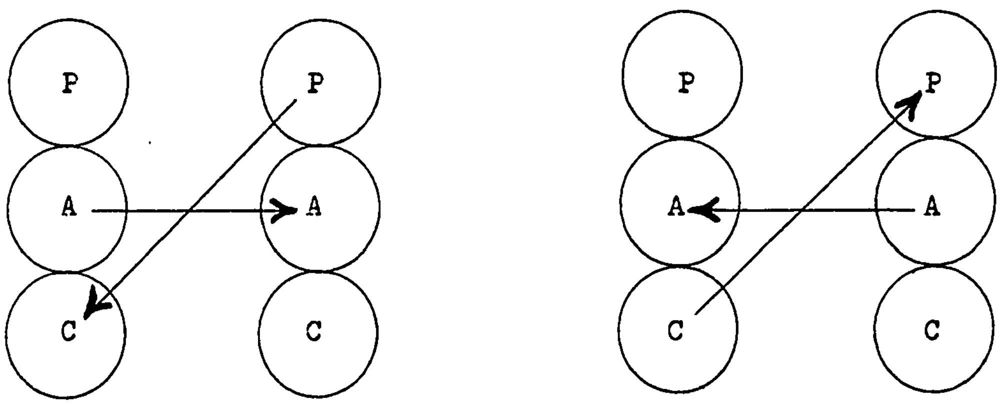
Berne: Complementary Transactions
(Adult-Adult and Parent-Child)[1]

[1]Ibid., p. 30.

In the diagram at the left in Figure 24, the stimulus comes from the Adult (for example, "When is the last filing date for the candidacy exam?"), and the response also comes from the Adult ("May 25th"). In the diagram at the right, the stimulus comes from the Child (for example, "Why can't I *ever* do *anything* right?"), and the response comes from the Parent ("Now, that's OK, don't worry about it"). The first rule of communication, according to Berne, is that,

> . . . communication will proceed smoothly as long as transactions are complementary; and its corollary is that as long as transactions are complementary, communication can, in principle, proceed indefinitely. These rules are independent of the nature and content of the transactions; they are based entirely on the directions of the vectors involved. As long as the transactions are complementary, it is irrelevant to the rule whether two people are engaging in critical gossip (Parent-Parent), solving a problem (Adult-Adult), or playing together (Child-Child or Parent-Child).[1]

The converse rule is that communication cannot proceed when a *crossed* transaction occurs--as, for example, in the diagrams in Figure 25.



Berne: Crossed Transactions[2]

Figure 25

[1]*Ibid.*

[2]*Ibid.*, p. 31.

In the diagram on the left, the stimulus comes from the Adult and is directed to the Adult ("When is the last filing date for the candidacy exam?"), but the response comes from the Parent and is directed to the Child ("Can't you ever manage to find these things out for yourself? What do you think we print catalogues for, anyway?"). In the diagram at the right, the stimulus comes from the Child ("Why can't I ever do anything right?") and is directed to the Parent, but the Adult responds to the Adult ("I don't know. Let's go over what you've done and see if we can find out"). In either situation, according to Berne, communication on the subject either breaks down entirely or progress is suspended until the vectors are realigned (that is, until one of the parties involved shifts to an ego state complementary to the other's).

In addition to the simple transactions represented above, which involve only two ego states, there are more complex transactions involving several ego states at once. These are called ulterior transactions, and include two types: angular transactions (which involve three ego states) and duplex transactions (which involve four). The significant feature of ulterior transactions is that they occur on two levels--the social (or ostensible) level and the psychological (or ulterior) level. The typical classroom transaction--"There will be a paper due on March 16th"/ "How many words does it have to be?"--is an ulterior transaction which, on the social level, is Adult-Adult, and on the psychological level is Parent-Child. The same rules which hold for simple transactions hold for ulterior transactions, however, and since the transactions at both levels in the example given are complementary, classroom communication can proceed indefinitely.

To summarize, then, the transactional model consists of four elements: 1) a system for analyzing simple or complex transactions (e.g., rituals, pasttimes, games) in terms of stroking behavior; 2) a system for categorizing broad patterns of interactions (i.e., life positions and life scripts); 3) a system for explaining intrapersonal behavior (i.e., the interaction of Parent, Adult, and Child ego states within the individual); and 4) a system for analyzing, explaining, and predicting the outcome of interpersonal transactions (the interaction of one person's ego states with those of another).

From both a systems perspective and a media ecology perspective, the transactional model has much to recommend it. It represents "personality," for example, not as the sum of the feelings and data recorded in the Parent, Adult, and Child, but as a complex whole with characteristics (a "life position," for example) produced by the interaction of the parts with one another (the intrapersonal system) and with the larger system (the interpersonal environment). Similarly, the larger system (the interpersonal transaction) is represented as a product of interactions among not only subsystems (person A and person B), but among sub-subsystems (Parent, Adult, and Child ego states), as well.

As a model of intrapersonal and interpersonal communication, the transactional model serves quite adequately a wide range of functions. As its use in psychotherapy suggests, it is not only a tool for describing communication processes, but a diagnostic instrument, as well. Parent, Adult, and Child ego states are, for the most part, behaviorally defined[1] and, consequently, quite easily recognizable with little training to both the self-observer and the interpersonal observer. For this reason, and because of the simplicity of its design, the transactional model has had wide application as an analytic tool in a number of contexts both inside and outside the field of psychology proper--for example, in business and management training. The transactional model serves, moreover, both normative and therapeutic functions. That is, it implies a standard for "healthy" communication behavior (generally, behavior characterized by ready movement from one ego state to another, but always under the supervision of the Adult), and a program for achieving it (generally, through strategies designed to develop Adult functions). It must also be stressed here that the transactional model is unique among the models reviewed in that it serves an explanatory function; that is,

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[1]The Parent, for example, is characterized linguistically by such utterances as "Everyone knows that. . . , You should always. . . , You should never. . . , People ought to. . . , Grown men don't. . . , How many times do I have to tell you. . . , This is good. . . , That's bad. . . ," and by such nonverbal behaviors as frowning, head-shaking, lip-pursing, jaw-clenching, eye-slitting, finger-shaking, and the like. The Child is characterized linguistically by "I wish. . . , I want. . . , I won't. . . , Can I. . . , Do I have to. . . , I'm mad at you! . . , Hey, great!" and the like, and by such noverbal behaviors as pouting, blushing, crying, whining, sulking, hand-wringing, pacing, wheedling, hand-raising, and avoiding eye contact. The Adult is characterized linguistically by "How. . . , What. . . , Where. . . , When. . . , Why. . . , Who. . ., Probably. . . , Sometimes. . . , In some instances. . . , Why don't we try to find out?" and by such nonverbal behaviors as leaning forward attentively and maintaining level eye contact.

it attempts to explain not only how people communicate, but why: to obtain the strokes they need not only to develop, but to survive.

On first impression, the most serious weakness in the transactional model, from the media ecologist's point of view, would seem to be its restricted scope. That is, while the model is quite useful for analyzing, describing, explaining, and even predicting certain outcomes of intra-personal and interpersonal communication, it says little or nothing about the interactions of individual and group, group and culture, or technology and culture. In fact, however, quite the opposite is true: perhaps the greatest potential of the transactional model for media ecology lies in its heuristic or analogical function. As Harris himself points out, we do not simply carry our Parent, Adult, and Child functions around with us in our heads; we tend to institutionalize them in various forms throughout the culture.[1] This view suggests several interesting lines of inquiry for media ecologists. If institutions as wholes may be said to represent either the Parent, Adult, or Child of the culture as a "psycho-logical organism," how would one classify schools? laws? the press? business? science? Within a given institution or structure, which agents or agencies represent Parental functions? More to the point, perhaps, What are the effects of the Parent-Adult-Child structure of institutions on the Parent-Adult-Child structures of the individuals who function within them? The purpose of school, to take an example, is preseumably to help children develop Adult functions and behaviors. But in its

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[1]Harris, I'm OK--You're OK, p. 245.

transactions with children, the school functions primarily as Parent. If the child attempts to develop his Adult ego state in school, then, he is caught in a crossed transaction, and, as Berne points out, communication must break down unless and until one of the parties shifts to a complementary ego state. The only complements to Parent ego states, however, are Parent and Child, and if the literal child is the party forced to give ground in the transaction with school (which seems more probable than the alternative), then he must adopt either a Parent or Child ego state for as long as the transaction continues. In either of those ego states, he cannot develop the Adult functions and behaviors which the school, according to its declared purposes, seeks to help him develop. As an analogical tool, the transactional model is useful not only for conceptualizing such problems as the school-child relationship, but for suggesting specific ways in which those problems might be alleviated, if not resolved. One of the critical factors in the development of a fully functioning Adult in children, for example, is the extent to which the child has freedom to explore his environment. Another, of course, is the richness of experience which the environment can provide. This would suggest two modifications in the conventional structure of school, if it is to promote Adult functions in the child: first, to allow the child greater mobility within the school environment, and second, to extend as far as possible outside the walls of the classroom the environment to which the child is exposed.

The need for data and direct experience in the development of Adult functions raises several interesting questions about the structure of institutions such as business and their effects on the ego states of the people who work within them. Even more interesting, perhaps, are the questions it raises about the role of media such as television in the Parent-Adult-Child structures, not only of children, but of grown-ups as well. On the one hand, television would seem to provide people with access to data not otherwise available to them; it extends their environments and, to that extent, may be said to serve an Adult function. On the other hand, the experience television provides is, like all information from the Parent, pre-packaged and not subject to the viewer's manipulation. In that sense, then, television may be said to function in relation to its viewers as Parent. The point here is not, of course, to resolve such problems or answer the questions they imply, but to suggest by raising them what the hueristic potential of the transactional model might be for studies in media ecology.

Like all models, the transactional conception of communication has its limitations. It gives almost no attention to the role in interpersonal communication, for example, of either context or codes. The scheme it provides for analyzing transactions more complex than those at the "ostensible" level is, moreover, difficult to apply, since it requires either more information about the motives of those engaged in the transactions than is usually available, or judgments about those motives that are difficult to validate. As a general framework for explaining, describing, and analyzing intrapersonal and interpersonal communication, however, and as an analogue for conceptualizing individual-group-institution-technology-culture interactions, the transactional model has extraordinary potential and deserves, in the investigator's judgment, a prominent place in the collection of research tools available to media ecologists.

CHAPTER 8

AN INTEGRATED CONCEPTUAL PARADIGM FOR THE STUDY OF HUMAN COMMUNICATION SYSTEMS

Media ecology, it was noted in Chapter 5, is the study of communication systems as environments. It takes as its basic subject matter the transactions between individual and reality, between one person and another, between individual and group, and between group and culture, and it seeks to identify the roles played in those transactions by the media through which they are conducted. Media ecology is concerned with human perception, feeling, understanding, value, and, most of all, change. Its concerns are, moreover, not merely theoretical, but pragmatic as well: it includes in its goals not only the description of communication processes and environments, but the diagnosis and solution of communication problems, both immediate and anticipated. In its pragmatic functions, however, media ecology is always limited (or should be) by its ecological perspective--that is, by the realization that 1) every communication system is more or less intimately connected with every other communication system in a complex net; 2) a change in one system produces effects throughout the net; 3) our knowledge of the transactions among the systems in the net is extremely limited; and therefore, 4) every effort to solve a problem or make an "improvement" in a particular communication environment will have, to some extent, unanticipated consequences in other environments.

These considerations lead the investigator to suggest that media ecology needs models of the communication process to serve three somewhat different functions: 1) at the highest level of abstraction, a model of the major systems which comprise the communication net, designed primarily to focus attention on the complexity of the net, to provide an organizing framework for media ecology subject matter, and to suggest lines of research into transystemic relationships; 2) at a lower order of abstraction, a model or set of models of communication elements and processes, designed primarily for organizing specific research into the effects of one variable on another within a particular system; and 3) a model or set of models for the solution of practical problems. This chapter proposes, therefore, models to serve each of these functions. The first two are combined in an integrated research paradigm for media ecology, described below. The third function is dealt with separately, toward the end of the chapter.

An Integrated Research Paradigm for Media Ecology

Communication is a process which links two or more elements together in an interacting system, so that the system as a whole has characteristics that are not reducible to the sum of the characteristics of the independent parts. This means, that, by definition, all systems are communication systems. The differences among them may be described in terms of 1) the nature and complexity of the interacting elements, 2) the functions of the parts in each system in relation to the whole, 3) the nature of the processes by which the elements interact, and 4) the relationships of the system under investigation to its subsystems and suprasystems. The model proposed here is designed to call attention to each of these characteristics of communication systems.

Media ecology is concerned primarily with human communication systems. For the purposes of organizing its subject matter and lines of research, these systems may be classified in three categories: primary systems, secondary systems, and tertiary systems. Primary systems are defined by the nature of the psychological or social units involved in a transaction. The transacting units in primary systems are always human. Secondary systems are the processing subsystems through which the units in the primary system interact. The nature of the components in secondary systems (i.e., human, sub-human, or non-human) depends on the level of the primary system within which they function. Tertiary systems are the subsystems of secondary systems, and their elements are almost always non-human.

The primary systems which media ecologists are concerned to study may be ordered hierarchically, as follows:

Level I: The intrapersonal system, in which the transacting units are the individual and reality, or the various "ego states" within the individual

Level II: The interpersonal system, in which the transacting units are two individuals

Level III: The intragroup system, in which the transacting units are three or more individuals acting as a unit in some respects

Level IV: The intergroup system, in which the transacting units are two or more groups with different roles, structures, and functions

Level V: The cultural system, in which the transacting units are formal or informal institutions or functions, and the "whole," defined as all the individuals, dyads, groups, and institutions in a system that shares a common symbol system, common values, a common history, and usually, a common territory

Level VI: The intercultural system, in which the transacting units are two or more cultures, defined by different symbol systems, different values, different institutions, different histories, and usually, different territories.

The primary communication systems which media ecologists are concerned to study are not independent of one another, but are inextricably linked in a complex network, which may be represented diagrammatically as in Figure 1.

Three comments on the preceding classification system should be made here before proceeding. First, the hierarchy of primary systems suggested above is an adaptation of the Ruesch and Bateson "levels of communication networks" model provided in Communication: The Social Matrix of Psychiatry[1] and discussed in Chapter 7. The "levels" have been modified to reflect more accurately the concerns of media ecologists, but otherwise follow Ruesch and Bateson's general conception. Second, the diagrammtic model of the communication network provided in Figure 1, although inadequate to represent the full complexity of the interactions

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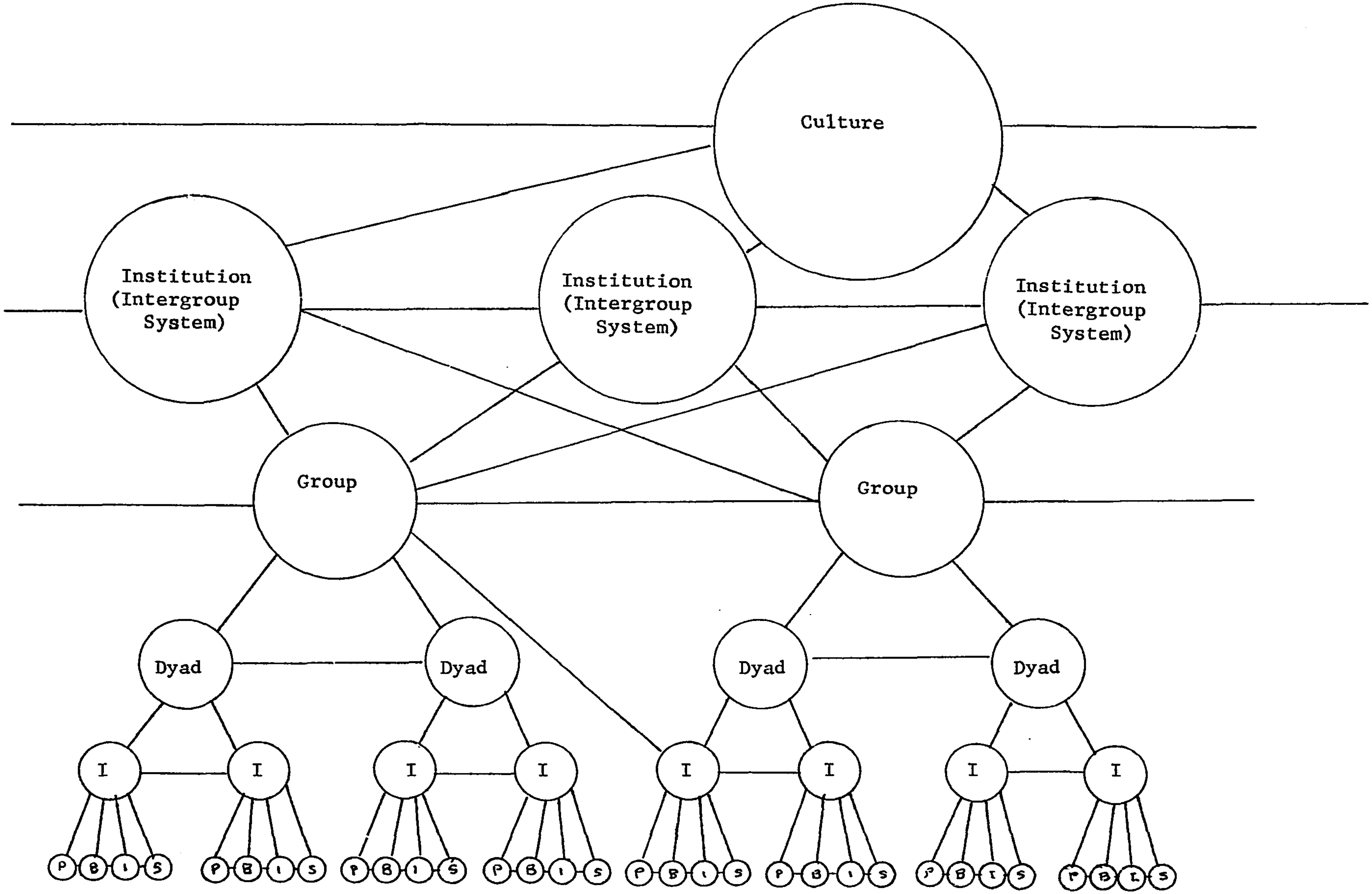
[1]Jurgen Ruesch and Gregory Bateson, Communication: The Social Matrix of Psychiatry (New York: W. W. Norton & Company, 1968), p. 275.



P=Psychological Structure
B=Biological Structure
I=Intellectual Structure
S=Social Structure
I=Individual

The Network of Communication Systems

Figure 1

among primary systems, is intended to remedy a deficiency in the Ruesch and Bateson model by stressing that the primary systems are not isolated and static, but organized in fact in dynamic interaction. In other words, each "level" in the hierarchy of primary systems is not only a subsystem of the next "level," but a suprasystem of a system at a "lower level" and, at the same time, what might be called a "parasystem" of others. Finally, the term "level," which is simply unavoidable in the kind of organization proposed here, must be understood by the reader to be divested of any meanings that suggest value judgments. The terms "higher level" and "lower level," as applied to systems, refer only to the relative scope of a system, not its quality or complexity.

In addition to the primary systems already identified, media ecologists are concerned to study the secondary systems through which the units in the primary system interact. These secondary systems may be called "components" to distinguish them from the "units" of primary systems, and may be classified generally as follows:

I: The source--one of the transacting units in a primary system, functioning as the originator of some data or message which the other unit in the transaction receives

II. The data or input--the "raw material" the source has available for sending into the system

III. The gatekeepers--those agents or agencies in the source that serve to filter (abstract from and modify) the data available for sending into the system

IV. The medium--a major component, composed of three subsystems (the tertiary systems referred to earlier), which may be called "elements" to distinguish them from the "components" of the secondary systems. These include:

A. The code--the signal or symbol system into which the input or data are transformed

B. The transmitter--the agent or agency which encodes and transmits the coded message

C. The channel--the agency through which the coded message is carried

D. The medium context--All those characteristics of the message environment determined by factors in the code, channel, and transmitter. It is a characteristic of the medium context of film that the environment in which it is used must be darkened. It is a characteristic of the medium context of speech that the source must be within a certain range of the destination. It is another characteristic of the medium context of speech that it can be received by any number of persons within a given range, whether or not they are part of the intended destination

V: The message sent--the message as understood from the source's point of view

VI: The receptors--the agents or agencies of the destination which first receive the codified, transmitted data from the source

VII: The gatekeepers--those agents or agencies in the receptors and destination which filter (abstract from and modify) the codified, transmitted data from the source

VIII: The destination--the other transacting unit or units in the primary system, functioning as the interpreter (meaning-maker) of the codified, transmitted data from the source

IX: The message received--the message as understood from the destination's point of view

X: The effectors--those agents or agencies of the destination which provide feedback to the source and act in other ways upon the message received.

The classification system for the secondary and tertiary communication systems proposed above is not really an adaptation of Ruesch and Bateson's model--nor, for that matter, of any single model reviewed in Chapter 7. It is, instead, an integration of concepts drawn from Shannon, Weaver, Wiener, Berlo, Westley and MacLean, Ruesch and Bateson, and several others, and adapted to the perspectives of media ecologists. It requires, therefore, a somewhat more extended discussion here than did the hierarchy of communication systems presented earlier. One important point that must be stressed is that, while the ordering of the secondary and tertiary systems proposed is intended to suggest the process through which the units in the primary system interact, it is not intended to suggest a strictly sequential process. Items III and VII--the gatekeepers in the source and destination--especially disturb the "elegance" of the classification system as a process model: in the first instance, because the item appears before the medium, which is itself a major gatekeeper, and in the second instance, because it appears between the receptors and the destination, both of which quite obviously serve gatekeeping functions of their own. The point is, however, that in every primary communication system, there are gatekeepers at several points in the transactional process. Including them here at two points is intended primarily to focus attention on their presence and effects.

Second, not all the secondary systems identified in the classification scheme provided are identifiable in all primary systems. In the intrapersonal system, for example, where "reality" is construed to be the source of the messages the individual receives, there are no gatekeepers interposed between the data and the medium. That is, a plant presumably does not screen the photons which bounce off it, or choose light waves as its channel for transmitting a message to the perceiver.

Third, it must be made quite clear that the process systems identified are roles or functions, not specific people or things. One person or agency, therefore, may serve as several "components" in the transactional process, performing different functions at different moments.

Perhaps the most significant feature of the model to be stressed here, however, is the somewhat unusual definition of medium, and its placement before the message in the classification system proposed. The medium is defined here as a single system composed of the code, transmitter, channel, and medium context, largely because 1) in practice, except at the most technical levels of communication analysis, the code, transmitter, channel, and medium context are either indistinguishable or not worth distinguishing among, and 2) media ecologists, as well as a wide range of other writers in communication theory, tend to use the word "medium" to refer to all four subsystems in interaction. The representation proposed here is designed both to permit focus on the code, or the transmitter, or the channel, or the medium context, as need arises, and to reflect the fact that these usually operate as a single subsystem in most of the primary systems media ecologists are concerned to study. The medium is placed before the message sent, in the model proposed, to reflect the point of view that, until the source has chosen (or had imposed on it) a code, transmitter, channel, and medium context, there is no message. To put it more succinctly, this arrangement reflects the Whorf-Sapir-Wittgenstein-Korzybski-Lee-Carpenter-McLuhan-*et al.* hypothesis that the medium determines the message.

Organizing the hierarchy of primary systems and the sequence of secondary and tertiary systems in a matrix results in the "Integrated Research Paradigm for Media Ecology" represented in Figure 2.

The matrix of communication systems provided in Figure 2 serves basically two functions: first, it organizes the subject matter of media ecology and provides a lexicon for talking about the communication systems and processes media ecologists are concerned to study. Second, it suggests two complementary lines of inquiry around which theory building and research can be organized. One would take as its focus the specification of characteristics (variables) in each of the primary, secondary, and tertiary systems identified, and the second would take as its focus the relationships among the various systems. It is not the purpose of the investigator to propose here a model for the analysis of variables in each of the primary, secondary, and tertiary systems identified in Figure 2. Suffice it to say that such studies may focus, in general, on the characteristics either of sources, or of data, or of gatekeepers, or of media, or of codes, or of transmitters, or of channels, or of media contexts, or of messages, or of receptors, or of destinations, or of effectors, in each of the levels of systems identified. Since most of those systems--with the very important exception of media contexts--are

	Source	Input (Data)	Gate-keepers	Medium	Message sent	Recep-tors	Gate-keepers	Destin-ation	Message Rcvd.	Effec-tors
I. Intra-personal System	"REALITY"	atoms, photons force fields, etc.	NONE. OR UNKNOWN	code TRANSMITTER Channel MEDIUM CONTEXT VARIABLE	VARIABLE	SENSORY ENDINGS	BIOLOGICAL STRUCTURE INTELLECTUAL STRUCTURE Psychological STRUCTURE Social STRUCTURE	INDIVIDUAL	VARIABLE	MUSCULATURE
II. Inter-personal System	Person A	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	Person B	VARIABLE	VARIABLE
III. Intra-group System	Person A DYAD A Group A	VARIABLE	Variable	VARIABLE	VARIABLE	VARIABLE	VARIABLE	Person B DYAD B Group B	VARIABLE	VARIABLE
IV. Inter-group System	Group A	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	Group B	VARIABLE	VARIABLE
V. Cultural System	Intergroup System A	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	Intergroup System B	VARIABLE	VARIABLE
VI. Intra-cultural System	Culture A	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	VARIABLE	Culture B	VARIABLE	VARIABLE

An Integrated Research Paradigm
for Media Ecology

Figure 2

already the subject of investigations in specialized fields such as psychology, physiology, biology, physics, chemistry, and linguistics, however, the investigator would strongly recommend that media ecologists focus primarily on the relationships among the systems identified.

Figure 2 suggests, in general, three sets of systemic relationships which media ecologists might examine: the relationship of one primary system to another, 2) the relationship of one secondary system to another and to its primary system, and 3) the relationship of one tertiary system to another, to its secondary system, and to its primary system. These relationships may be described in terms of the roles and functions of one system in relation to another, and in terms of the effects of one system upon another. The following outline of questions may serve as a general research model for the study of systemic relationships.

1.0 Primary System Relationships

1.1 What is the communication function of each intrapersonal system (i.e., person) in particular dyads in particular contexts? Does one person serve as "information source" for the dyad as a whole in certain contexts? Does one person serve as "receptor" for the dyad as a whole in certain contexts? Does one person serve as the "medium" through which the dyad communicates with other systems? Does one of the two people serve as "effector" for the dyad in certain contexts? Who or what functions as "gatekeeper" for the dyad as a whole, in what contexts? In what contexts do the two participants in a dyad exchange roles as receptors, media, effectors, gatekeepers, and so on? What are the effects on each intrapersonal system of the interpersonal system as a whole?

1.2 What is the communication function of each intrapersonal and interpersonal system as a whole in a group? Which individuals, dyads, or small groups function as the "information source" for the group as a whole? Which individuals, dyads, or small groups function as "gatekeepers" for the group as a whole? Which function as media? As receptors? As destinations (interpretors or coordinators of messages)? Which individuals, dyads, or small groups function as "effectors" for the group as a whole? In what contexts, if any, do the members of the group exchange functions? What are the effects of intragroup systems on the intrapersonal and interpersonal systems within the group?

1.3 What is the communication function of each group in an intergroup system (a university, for example)? Which groups function as information sources for the intergroup system as a whole? Which groups function as gatekeepers? Which groups function as media? As interpretors or coordinators? Which group functions as effector for the system? What are the effects of the intergroup system on the intragroup systems of which it is composed? What are the effects of the intergroup system on the interpersonal and intrapersonal systems which function within it?

1.4 What is the communication function of each intergroup system as a whole in a culture? Which intergroup systems (for example, governmental agencies, courts, school systems, the press) function as information sources for the culture? Which function as media? Which function as gatekeepers? Which function as effectors? Which function as message interpreters and coordinators? What are the effects of the culture as a whole on the intergroup systems which comprise it? What are the effects of the culture on intragroup, interpersonal, and intrapersonal systems?

1.5 Do different cultures as wholes serve different communication functions in an intercultural system? Do certain cultures function primarily as information sources, or as media, or as gatekeepers, while others function primarily as interpreters or coordinators or effectors of intercultural systems? What are the effects of intercultural systems on the cultures which comprise them?

1.6 Within what larger systems do intercultural systems function, and how are they related?

2.0 Secondary System Relationships

2.1 What are the functions of the information source in relation to an intrapersonal system as a whole? In relation to an interpersonal system as a whole? To an intragroup system? To an intergroup system? To a cultural system? To an intercultural system? What are the effects of the source on the system as a whole at each level?

2.2 What are the functions of the source in relation to the input in a system at a given level? What are its functions in relation to the gatekeepers? To the medium? To the message sent?

To the receptors of the system? To the interpreters? To the effectors? What are the effects of the characteristics of the source on input, gatekeepers, media, message sent, receptors, message received, destination, and effectors?

2.3 What are the functions of data in relation to each primary system as a whole? What are the effects of characteristics of data on the system as a whole at each level?

2.4 What are the functions of data in relation to the source, gatekeepers, medium, message sent, receptors, gatekeepers, destination, message received and effectors in a system at a given level? What are the effects of the characteristics of data on each of the other secondary systems at that level?

2.5 What are the functions of the gatekeepers in relation to each primary system as a whole? What are the effects of the characteristics of the gatekeepers on the system as a whole?

2.6 What are the functions of the gatekeepers in relation to the source, data, medium, message sent, receptors, destination, message received, and effectors in a system at a given level? What are the effects of characteristics of the gatekeepers on each of the other secondary systems at that level?

2.7 What are the functions of the medium in each primary system as a whole? What are the effects of characteristics of the medium on the system as a whole at each level?

2.8 What are the functions of a medium in relation to the source, data, gatekeepers, message sent, receptors, gatekeepers, destination, message received, and effectors in a system at given level? What are the effects of characteristics of the medium on each of the other secondary systems at that level?

2.9 What are the functions of the message sent in each primary system as a whole? What are the effects of characteristics of the message sent on the system as a whole at each level?

2.10 What are the functions of the message sent in relation to each of the other secondary systems in a primary system at a given level? What are the effects of characteristics of the message sent on each of the other secondary systems at that level?

2.11 What are the functions of the receptors in each primary system as a whole? What are the effects of characteristics of the receptors on the system as a whole at each level?

2.12 What are the functions of the receptors in relation to each of the other secondary systems at a given level? What are the effects on each of those systems of the characteristics of the receptors?

2.13 What are the functions of the gatekeepers in the destination, in each primary system as a whole? What are the effects of characteristics of those gatekeepers on the system as a whole at each level?

2.14 What are the functions of the gatekeepers in the destination, in relation to each of the other secondary systems at a given level? What are the effects of characteristics of the gatekeepers on each of the other secondary systems at that level?

2.15 What are the functions of the destination in each primary system as a whole? What are the effects of characteristics of the destination on the system as a whole at each level?

2.16 What are the functions of the destination in relation to each of the other secondary systems at a given level? What are the effects of characteristics of the destination on each of the other secondary systems at that level?

2.17 What are the functions of the message received in each primary system as a whole? What are the effects of characteristics of the message received on the system as a whole at each level?

2.18 What are the functions of the message received in relation to each of the other secondary systems c a given level? What are the effects of characteristics of the message received on each of the other secondary systems at that level?

2.19 What are the functions of the effectors in each primary system as a whole? What are the effects of characteristics of the effectors on the system as a whole at each level?

2.20 What are the functions of the effectors in relation to each of the other secondary systems at a given level? What are the effects of characteristics of the effectors on each of the other secondary systems at that level?

3.0 Tertiary System Relationships

3.1 What is the function of the code in relation to the medium as a whole in each system? What is the function of the channel in relation to the medium as a whole in each system? What is the function of the transmitter in relation to the medium as a whole in each system? What is the function of the medium context to the medium as a whole in each system? What are the effects of characteristics of the code, transmitter, channel, and medium context on the medium as a whole in each system?

3.2 What is the function of the code in relation to the channel in a given system? What is its function in relation to the transmitter? To the medium context? What are the effects of characteristics of the code on the channel, transmitter, and medium context?

3.3 What is the function of the transmitter in relation to the code, to the channel, and to the medium context in a given system? What are the effects of characteristics of the transmitter on the code, channel, and medium context?

3.4 What is the function of the channel in relation to the code, transmitter, and medium context in a given system? What are the effects of characteristics of the channel on the code, transmitter, and medium context?

3.5 What is the function of the medium context in relation to the code, transmitter, and channel in a given system? What are the effects of characteristics of the medium context on the code, transmitter, and channel?

As noted earlier, the integrated research paradigm proposed here is intended to serve primarily two functions: to organize the subject matter of media ecology and provide a lexicon for describing communication systems, and to organize research. It is also designed to focus the attention of media ecologists on the following principles:

1. Every communication system and process is connected with every other communication system and process in a complex network.

2. The study of communication processes is the study, not of elements, but of elements in relationships.

3. A relationship may be defined in terms of the function of one element in regard to another and to the larger system they comprise, and in terms of the effects of one element on another and on a larger system.

4. The function of any element in communication can only be defined in terms of the system it is operating within.

5. Different "things" serve different functions in different communication systems. A television set, for example, may be an information source in one system, a medium in a second, a receptor in a third, and an effector in a fourth.

6. In observing and describing any communication system, therefore, one must specify the "level" or the parameters of the system one is focusing on.

7. The choice of point of view in the study of communication systems (i.e., which "level" to focus upon) depends on the purposes of the observer and the nature of the problem at hand.

Guidelines for the Use of Specialized Models

The last principle stated in the preceding section of this chapter—namely, that the choice of point of view in any communication analysis depends on the purposes of the observer and the nature of the problem at hand—applies not only to choosing a particular focus within the network of communication systems, but to choosing the model on which one's observations will be based. For every communication model is, in effect, a point of view. And every model is, therefore, limited in the purposes it can serve. In the investigator's opinion, the integrated model proposed in the preceding section of this chapter is well suited to the purposes of organizing media ecology research. Because it is a synthesis, however, and because it aims for the broadest possible scope, it leaves out many of the valuable details which the more specialized models reviewed in Chapter 7 can provide. For the more immediate, pragmatic purposes of media ecologists, therefore, it is proposed that the models reviewed in Chapter 7 be used intact, the choice of model always depending on the purposes of the observer and the problem at hand. The following guidelines reflect the investigator's judgment about which of the models reviewed is best suited to what general contexts, problems, and purposes.

When the problem is	And the context is	And the purpose is	Model
Technical (involving mechanical or physical distortions in the coding, transmitting receiving, decoding processes)	machine-machine machine-man man-machine subhuman	descriptive analytic therapeutic	Shannon-Weaver-Wiener
Syntactic (involving the elements in codes and the ways in which they are organized)	language gesture music etc.	descriptive analytic	Structural Linguistics
Semantic (involving the relationship of codes to their referents in reality, and the relationship of meaning-making to codes)	intrapersonal interpersonal	descriptive analytic therapeutic	Ames Morris General Semantics
	mass communications	descriptive analytic	Westley-MacLean
	cultural	descriptive analytic	Whorf-Sapir

When the problem is	And the context is	And the purpose is	Model
Pragmatic (involving the relationship of messages to their effects on audiences)	interpersonal	descriptive analytic therapeutic	Morris Berlo
	social (groups)	descriptive analytic	Goffman
Affective (involving the relationship of communication behavior in general to feeling and value)	intrapersonal interpersonal	descriptive analytic therapeutic	Ames Berne-Harris

Summary and Conclusions

The integrated research paradigm and the guidelines for the use of specialized communication models proposed in this study are not intended to conclude, but rather to initiate what the investigator hopes will be an ongoing process of paradigm search, testing, and devolopment in media ecology. If that process is to be genuinely productive, it must follow, in the present writer's opinion, two complementary courses: on the one hand, the evaluation and critique of existing models of communication from a theoretical perspective which reflects the world view not only of media ecologists, but of all ecological scientists; and, on the other, the rigorous testing, in the practical contexts which concern media ecologists, of the new and revised models to which theoretical critiques of earlier models may lead.

The present study has attempted both to articulate the theoretical perspective from which media ecologists may examine and evaluate communication theories and models from specialized disciplines, and to provide an integrated paradigm more useful than any of the specialized models reviewed for structuring the perspective, questions, and research of media ecologists. It is hoped that, in both these respects, the study may serve as a stimulus and a structure for further practical and paradigmatic research, thus advancing in some small way the development of media ecology as a discipline.

BIBLIOGRAPHY

Ames, Adelbert. The Morning Notes of Adelbert Ames. Edited and with a preface by Hadley Cantril. New Brunswick, N.J.: Rutgers University Press, 1960.

Ashby, W. R. An Introduction to Cybernetics. New York: John Wiley & Sons, 1956.

Baier, Kurt and Rescher, Nicholas, eds. Values and the Future. New York: The Free Press, 1969.

Barnett, Lincoln. The Universe and Dr. Einstein. Revised edition with a Foreword by Albert Einstein. New York: Bantam Books, 1968.

Bateson, Gregory. Steps to an Ecology of Mind. New York: Ballantine Books, 1972.

Berlo, David K. The Process of Communication: An Introduction to Theory and Practice, New York: Holt, Rinehart and Winston, Inc., 1960.

Berne, Eric. Transactional Analysis in Psychotherapy. New York: Grove Press, 1961.

________. Games People Play: The Psychology of Human Relationships. New York: Grove Press, 1967.

Bertalanffy, Ludwig von. "Zu einer allgemeinen Systemlehre." Duetsche Zeitschrift fur Philosophie, XVIII, 3/4 (1945).

________. "An Outline of Gneral System Theory," British Journal of the Philosophy of Science, I (1950), pp. 139-164.

________. Problems of Life. New York: John Wiley & Sons, 1952.

________. Robots, Men and Minds: Psychology in the Modern World. New York: George Braziller, Inc., 1967.

________. General System Theory: Foundations, Development, Applications. New York: George Braziller, Inc., 1968.

Birdwhistell, Ray L. Kinesics and Context. Philadelphia: University of Pennsylvania Press, 1970.

Black, Max. Models and Metaphors. Ithaca, N.Y.: Cornell University Press, 1962.

Bloch, Bernard, and Trager, George L. Outline of Linguistic Analysis. Baltimore: Linguistic Society of America, 1946.

Bloomfied, Leonard. Language. New York: Henry Holt & Company, 1933.

Blum, G. S. Psychoanalytic Theories of Personality. New York: McGraw-Hill Book Company, 1953.

Boas, Franz. Handbook of American Indian Languages. Washington, D.C.: Smithsonian Institution, 1911.

Born, Max. Physics in My Generation. London and New York: Pergamon Press, 1956.

Boulding, Kenneth E. The Organizational Revolution. New York: Harper Brothers, 1953.

________. The Image: Knowledge in Life and Society. Ann Arbor, Mich.: 1956.

________. "General Systems Theory--The Skeleton of Science." General Systems, I (1956), pp. 11-17.

________. The Meaning of the 20th Century: the Great Transition. World Perspectives Series. Harper Colophon Books. New York: Harper & Row, Publishers, Inc., 1965.

Bridgman, Percy W. The Way Things Are. Cambridge, Mass.: Harvard University Press, 1959.

Broadbent, Donald E. Perception and Communication. New York: Pergamon Press, 1958.

Bronowski, J. The Common Sense of Science. A Modern Library Paperback. New York: Random House, Inc., 1959.

Campbell, N. R. Physics, the Elements. Cambridge: Cambridge University Press, 1920.

Cantril, Hadley. The "Why" of Man's Experience. New York: The Mac-Millan Company, 1950.

________, ed. The Morning Notes of Adelbert Ames. New Brunswick, N.J.: Rutgers University Press, 1960.

Carpenter, Edmund. "The New Languages." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

________, and McLuhan, Marshall, eds. Explorations in Communication. Boston: Beacon Press, 1966.

Carroll, John B. "Communication Theory, Linguistics, and Psycholinguistics." Review of Educational Research, XXVIII (1958), pp. 79-80.

________. Language and Thought. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.

Cassirer, Ernst. Language and Myth. New York: Harper & Brothers, 1946.

Chao, Yuen Ren. "Models in Linguistics and Models in General." Logic, Methodology and Philosophy of Science: Proceedings of the 1960 International Congress. Edited by Ernest Nagel, Patrick Suppes, and Alfred Tarski. Stanford, Cal.: Stanford University Press, 1962.

Chase, Stuart. The Power of Words. New York: Harcourt, Brace & World, 1954.

Cherry, Colin. "The Communication of Information." American Scientist, XL (1952), pp. 640-663.

________. On Human Communication: A Review, A Survey, and a Criticism. Studies in Communication. Cambridge, Mass.: Technology Press of Massachusetts Institute of Technology, 1957.

Chomsky, Noam. Syntactic Structures. The Hague: Mouton Press, 1957.

________. "Three Models for the Description of Language." Communication and Culture. Edited by Alfred G. Smith. New York: Holt, Rinehart and Winston, 1966.

________. Language and Mind. New York: Harcourt, Brace & World, 1968.

________. American Power and the New Mandarins. New York: Vintage Books, 1969.

DeBroglie, Louis. Matter and Light: The New Physics. New York: Horton Press, 1939.

DeFleur, Melvin. Theories of Mass Communication. New York: David McKay Company, Inc., 1966.

Demerath, N. J., and Peterson, R. A., eds. System, Change and Conflict. New York: The Free Press, 1967.

Deutsch, Karl. "On Communication Models in the Social Sciences." Public Opinion Quarterly, XVI (1952), pp. 356-380.

DeVito, Joseph A. The Psychology of Speech and Language: An Introduction to Psycholinguistics. New York: Random House, 1970.

________. General Semantics: Guide and Workbook. Deland, Fla.: Everett/Edwards, Inc., 197.

Giedion, S. "Space Conception in Prehistoric Art." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Goffman, Erving. The Presentation of Self in Everyday Life. Garden City, N.Y.: Doubleday & Company, Inc., 1959.

Griffiths, Daniel E. "The Nature and Meaning of Theory." Behavioral Science and Educational Administration. N.S.S.E. Yearbook, Part II, 1964. Chicago: University of Chicago Press, 1964.

Grinker, Roy R., ed. Toward a Unified Theory of Human Behavior. New York: Basic Books, 1956.

Hall, A. D., and Fagen, R. E. "Definition of System." General Systems, I (1956), pp. 18-28.

Harris, Thomas A. I'm OK--You're OK: A Practical Guide to Transactional Analysis. New York: Harper & Row, 1969.

Harrison, Randall. "Communication Theory." Educational Media: Theory into Practice. Edited by Ray V. Wiman and W. C. Meierhenry. New York: Holt, Rinehart and Winston, Inc., 1969.

Harvard University Program on Technology and Society, 1964-1972. A Final Review. Cambridge, Massachusetts, 1972.

Hayakawa, S. I. Language in Thought and Action. New York: Harcourt, Brace & Company, 1947.

Hearn, Gordon. Theory Building in Social Work. Toronto: University of Toronto Press, 1958.

Heisenberg, Werner. Physics and Philosophy: The Revolution in Modern Science. World Perspectives Series. Harper Torchbooks. New York: Harper & Row, 1962.

________. The Physicist's Conception of Nature. Translated by Arnold J. Pomenans. New York: Harcourt, Brace & Company, 1958.

Hesse, Mary B. Models and Analogies in Science. Notre Dame, Ind.: University of Notre Dame Press, 1966.

Hobbes, Thomas. Leviathan. New York: Oxford University Press, 1947.

Immegart, Glenn L. "Systems Theory and Taxonomic Inquiry into Organizational Behavior in Education." Developing Taxonomies of Organizational Behavior in Education Administration. Edited by Daniel E. Griffiths. Rand McNally Educational Administration Series. Chicago: Rand McNally & Company, 1969.

Dewey, John, and Bentley, Arthur. Knowing and the Known. Boston: Beacon Press, 1949.

Dexter, Lewis Anthony, and White, David Manning, eds. People, Society and Mass Communications. New York: The Free Press, 1964.

Drucker, Peter F. The Age of Discontinuity. New York: Harper & Row, 1968.

Duhem, Pierre. The Aim and Structure of Physical Theory. Translated by Philip P. Wiener. Princeton, N.J.: Princeton University Press, 1954.

Duncan, Hugh Dalziel. Communication and Social Order. London, Oxford, New York: Oxford University Press, 1968.

Ellul, Jacques. The Technological Society. New York: Vintage Books, 1964.

Fearing, Franklin. "Toward a Psychological Theory of Human Communication." Journal of Personality, XXII (1953), pp. 71-87.

________. "An Examination of the Conceptions of Benjamin Lee Whorf in the Light of Theories of Perception and Cognition." Language in Culture. Edited by Harry Hoijer. Chicago: University of Chicago Press, 1954.

Fishman, Joshua, "A Systematization of the Whorfian Hypothesis." Behavioral Science, V (1960), pp. 323-339.

Frank, Lawrence K. "Tactile Communication." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Fries, Charles Carpenter. The Structure of English. New York: Harcourt, Brace & World, 1952.

Fuller, R. Buckminster. Utopia or Oblivion. New York: Bantam Books, 1969.

Gagne, Robert M., et al. Psychological Principles in System Development. New York: Holt, Rinehart and Winston, Inc., 1966.

General Systems, The Yearbook of the Society for General Systems Research, I-XX (1954-1973).

Gerbner, George. "Toward a General Model of Communication." Audio-Visual Communication Review, IV (Summer, 1956), pp. 171-199.

Gibson, Arthur. "The Soviet Press." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Innis, Harold A. The Bias of Communication. Toronto: University of Toronto Press, 1951.

Ittelson, W. H., and Cantril, Hadley. Perception: A Transactional Approach. Garden City, N.Y.: Doubleday & Company, 1954.

Johnson, F. Craig, and Klare, George R. "General Models of Communication Research." Journal of Communication, XI (1961), pp. 13-26.

Johnson, Wendell. People in Quandaries. New York: Harper & Brothers, 1946.

Jordan, Pascual. Physics of the Twentieth Century. New York: Philosophical Library, 1944.

Kahn, Herman. On Thermonuclear War. Princeton, N.J.: Princeton University Press, 1960.

Kaplan, Abraham. The Conduct of Inquiry. San Francisco: Chandler Publishing Company, 1964.

Kelley, Earl. Education for What is Real. With a preface by John Dewey. New York: Harper & Brothers, 1947.

Keltner, John W. Interpersonal Speech Communication: Elements and Structures. Belmont, Cal.: Wadsworth Publishing Company, Inc., 1970.

Klapper, Joseph T. The Effects of Mass Communication. New York: The Free Press, 1960.

Kluckhohn, Clyde. Mirror for Man. New York: McGraw-Hill Book Company, 1949.

Korzybski, Alfred. Science and Sanity. Lakeville, Conn.: International Non-Aristotelian Library Publishing Company, 1933.

Kuhn, Thomas S. The Structure of Scientific Revolutions. Second edition, enlarged. International Encyclopedia of Unified Science, II, 2. Chicago: University of Chicago Press, 1970.

Langer, Susanne K. Philosophy in a New Key. Cambridge, Mass.: Harvard University Press, 1942.

________. Feeling and Form. New York: Charles Scribner & Sons, 1953.

Laszlo, Ervin. The Systems View of the World. New York: George Braziller, Inc., 1972.

________, ed. The Relevance of General Systems Theory. New York: George Braziller, Inc., 1972.

Lee, Dorothy. Freedom and Culture. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1959.

________. "Lineal and Non-Lineal Codifications of Reality." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Leger, Fernand. "Pure Color." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Lyons, John. Noam Chomsky. Modern Masters Series. Edited by Frank Kermode. New York: Viking Press, 1970.

MacKay, Donald M. Information, Mechanism and Meaning. Cambridge, Mass.: M.I.T. Press, 1969.

Mandelbaum, David, ed. Selected Writings of Edward Sapir. Berkeley, Cal.: University of California Press, 1949.

Maslow, Abraham H. The Psychology of Science. A Gateway Edition. Chicago: Henry Regnery Company, 1969.

Matson, Floyd W. The Broken Image: Man, Science and Society. Anchor Books. Garden City, N.Y.: Dobleday & Company, Inc., 1966.

McHale, John. The Future of the Future. New York: Ballantine Books, Inc., 1971

McLuhan, Marshall. The Mechanical Bride: Folklore of Industrial Man. New York: Vanguard Press, 1951.

________. The Gutenberg Galaxy: The Making of Typographic Man. Toronto: The University of Toronto Press, 1962

________. Understanding Media: The Extensions of Man. New York: McGraw-Hill Book Company, 1965.

________. "Acoustic Space." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

________. "The Effect of the Printed Book on Language." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan.

Mead, George H. Mind, Self, and Society. Chicago: University of Chicago Press, 1934.

Mead, Margaret, ed. Cultural Patterns and Technical Change. Mentor Books. New York and Toronto: The New American Library, 1955.

Moran, Terence P.; Postman, Neil; and Weingartner, Charles, eds. Language in America. New York: BobbsMMerrill, Inc., 1968.

Morris, Charles. Signs, Language and Behavior. New York: George Braziller, Inc., 1946.

Mumford, Lewis. Technics and Civilisation. London: George Routledge & Sons, Ltd., 1945.

________. The Myth of the Machine: Technics and Human Development. New York: Harcourt, Brace & World, Inc., 1967.

________. The Myth of the Machine: The Pentagon of Power. New York: Harcourt, Brace & World, Inc., 1970.

Murphy, Gardner. "Toward a Field Theory of Communication." Journal of Communication, XI (1961), pp. 196-201.

Murray, Elwood. "Future Directions in Communication Research: An Assessment of the Possible Use of Analogues." Journal of Communication, XI (1961), pp. 3-12, 33.

Nagel, Ernest; Suppes, Patrick; and Tarski, Alfred, eds. Logic, Methodology and Philosophy of Science: Proceedings of the 1960 International Congress. Stanford, Cal.: Standford University Press, 1962.

Newman, John B. "A rationale for a Definition of Communication." Journal of Communication, X (1960), pp. 115-124.

Oppenheimer, J. Robert. Science and the Common Understanding. New York: Simon and Schuster, 1954.

Pike, Kenneth L. The Intonation of American English. Ann Arbor, Mich.: University of Michigan Press, 1946.

Pollard, William G. "The Significance of Complementarity for the Life Sciences." American Journal of Physics, XX (1952).

Postman, Neil. "The Reformed English Curriculum." High School 1980: The Shape of the Future in American Secondary Education. Edited by Alvin C. Eurich. New York: Pitman Publishing Corporation, 1970.

________, and Weingartner, Charles. Teaching as a Subversive Activity. A Delta Book. New York: Dell Publishing Co., Inc., 1969.

________, and Weingartner, Charles. The Soft Revolution: A Student Handbook for Turning Schools Around. A Delta Book. New York: Dell Publishing Co., Inc., 1971.

Rapoport, Anatol. Science and the Goals of Man. New York: Harper & Brothers, 1950.

________. Operational Philosophy: Integrating Knowledge and Action. New York: Harper & Brothers, 1953.

________. "The Search for Simplicity." The Relevance of General Systems Theory. Edited by Ervin Laszlo. New York: George Braziller, Inc., 1972.

Riesman, David. "The Oral and Written Traditions." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Rosenberg, Bernard, and White, David Manning, eds. Mass Culture. New York: The Free Press, 1956.

Ruesch, Jurgen, and Bateson, Gregory. Communication: The Social Matrix of Psychiatry. New York: W. W. Norton & Company, 1968.

Schramm, Wilbur. The Process and Effects of Mass Communication. Urbana, Ill.: University of Illinois Press, 1949.

Scientific American, September, 1972.

Seldes, Gilbert. "Communications Revolution." Explorations in Communication. Edited by Edmund Carpenter and Marshall McLuhan. Boston: Beacon Press, 1966.

Shannon, Claude E., and Weaver, Warren. The Mathematical Theory of Communication. Urbana, Ill.: University of Illinois Press, 1949.

Smith, Alfred G., ed. Communication and Culture. New York: Holt, Rinehart and Winston, Inc., 1966.

Smith, Raymond G. Speech-Communication: Theory and Models. New York: Harper & Row, Publishers, 1970.

Sondel, Bess Selzer. The Humanity of Words. New York: The World Publishing Company, 1958.

Stevens, S. S. "A Definition of Communication." Journal of the Acoustical Society of America, XXII (November, 1950), pp. 689-690.

Sullivan, Harry Stack. The Interpersonal Theory of Psychiatry. New York: W. W. Norton & Company, 1953.

Sullivan, J. W. N. The Limitations of Science. New York: Mentor Books, 1949.

Teilhard de Chardin, Pierre. The Pheonomenon of Man. Harper Torchbooks. New York: Harper & Row, Publishers, 1960.

Thayer, Lee. "Communication Systems." The Relevance of General Systems Theory. Edited by Ervin Laszlo. New York: George Braziller, Inc., 1972.

_______. ed. Communication: Theory and Research: Proceedings of the First International Symposium. Springfield, Ill.: Charles C. Thomas, Publisher, 1967.

_______. ed. Communication: Concepts and Perspectives: Proceedings of the Second International Symposium. Washington, D.C.: Spartan Books, 1967.

The Annual Guides to Graduate Study. Princeton: Peterson's Guides, Inc., 1972.

The College Handbook. Princeton: College Entrance Examination Board, 1972.

Toffler, Alvin. Future Shock. New York: Random House, Inc., 1970.

_______, ed. The Futurists. New York: Random House, Inc., 1972.

Trager, George L., and Smith, Henry Lee. Outline of English Structure. Norman, Okla.: University of Oklahoma Press, 1951.

Weaver, Warren. "The Mathematics of Communication." Scientific American, CLXXXI (1949), pp. 11-15. Reprinted in Communication and Culture. Edited by Alfred G. Smith. New York: Holt, Rinehart and Winston, Inc., 1966.

Webster's New International Dictionary, 2nd edition, 1934.

Westley, Bruce H., and MacLean, Malcolm S., Jr. "A Conceptual Model for Communications Research." Journalism Quarterly, XXXIV (1957), pp. 31-38.

Whatmough, Joshua. Language: A Modern Synthesis. A Mentor Book. New York: The New American Library, 1956.

Whitehead, Alfred North. Symbolism, Its Meaning and Effect. New York: The Macmillan Company, 1927.

_______. Science and the Modern World. New York: Mentor Books, 1948.

Whorf, Benjamin Lee. Language, Thought and Reality: Selected Papers. Edited by John B. Carroll. Cambridge, Mass.: M.I.T. Press, 1956.

Wiener, Norbert. Cybernetics. New York: John Wiley & Sons, 1948.

_______. The Human Use of Human Beings: Cybernetics and Society. Discus Books. New York: Avon Books, 1967.

Wolff, Harold G. "The Mind-Body Relationship." An Outline of Man's Knowledge of the Modern World. Edited by Lyman Bryson. Garden City, N.Y.: Nelson Doubleday, 1960.

Young, O. R. "A Survey of General Systems Theory," _General Systems_, IX (1964), pp. 61-82.