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COMMUNICATION THEORY in the CAUSE of MAN

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Notes on the application of General Systems Theory, Cybernetics, Information Theory, and related fields of Communication Theory to the strengthening of democratic institutions on our planet.

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NOTE ON REVISIONS AND ADDITIONS TO CTCM:

'7' in File No. 100-F-7 indicates updating to August 30, 1970.
'10' in File No. 98-F-10 indicates updating to March 28, 1971.
'14' in File No. 97-F-14 indicates updating to March 5, 1972.
'15' in File No. 97-F-15 indicates updating to June 18, 1972.
'16' in File No. 97-F-16 indicates updating to July 16, 1972
'17' in File No. 97-F-17 indicates updating to January 1, 1973
'18' in File No. 397-F-18 indicates updating to March 18, 1973.

Starting with this issue of CTCM, the title pages and editorial notes have been renumbered from Section 0.9.9 to Section 3.9.7. This is consistent with putting such temporary material in an appendix at the end of the loose-leaf book that can be put together on a do-it-yourself basis by unstapling the back issues of CTCM and refiling them by the "file numbers."

For the benefit of the new reader who has not followed the earlier issues, an abridged outline of the projected loose-leaf book is displayed below. For a more detailed outline and listing of which sections have been printed to date, see CTCM, Vol. II, No. 3, pages 11-22 (Section 1.0.1).

Short Outline of the Proposed Book
COMMUNICATION THEORY in the CAUSE of MAN:

Book One: Interpretation of Cybernetics, Etc., for the Layman-Citizen

- 1.0 Background Material and Basic Concepts
- 1.1 General Introduction
- 1.2 Analogies in Sociological Problems from the Technical Level
- 1.3 Problems on the Semantic Level
- 1.4 Problems on the Effective Level
- 1.5 More Complex Problems
- 1.6 An Integrative Framework for a New Frontier

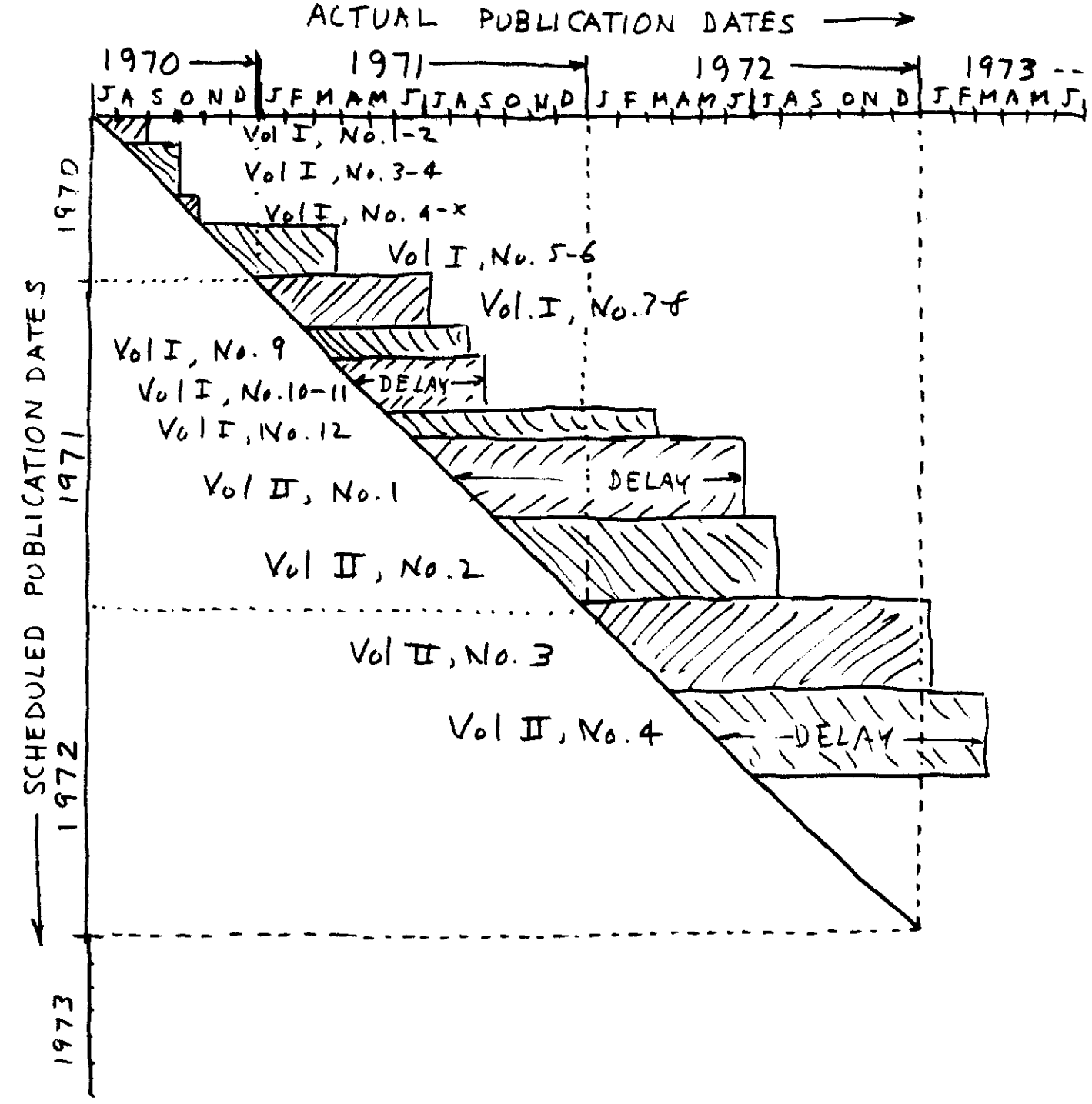
Book Two: Application of Principles of Information Theory, Etc., to Practical Problems for the Social Technician and Systems Engineer

- 2.1 Implications of Multidisciplinary Concepts
- 2.2 Application of Cybernetic Technologies
- 2.3 Applications for Implimenting Ethical Principles
- 2.4 Theories of Social Evolution
- 2.5 Stimulation of Creative Evolution in Human Society
- 2.6 Application of Cybernetics to Human Communication Problems

Book Three: Mathematical and Scientific Background for the Philosopher and Scientist

- 3.1 Mathematical Concepts
- 3.2 Sample Calculations
- 3.3 Status of Entropy and Information
- 3.4 Information Theory
- 3.5 Cybernetics
- 3.6 Simulation
- 3.7 Physical Science
- 3.8 Glossary
- 3.9 Bibliography, Notes & Index

I have received some word that people are confused by the long and irregular time intervals between issues of CTCM. I regret that many events beyond my control disturb the publication schedule. So the reader may draw his own conclusions as to how the publication schedule fluctuates, I have drawn a graph of the publication dates of CTCM.



Each week there is some item in the San Jose Unitarian Church Bulletin which tells about some social or political problem of some urgency. I give some thought to problems described by the Social Concerns Committee, the Women's Cadre, the Long Range Planning Committee, and the sermons of the minister. Some of these social problems are potentially analyzable more fruitfully by techniques of cybernetics, information theory, and general systems theory. However there is a gap between the philosophical papers published in ZYGON magazine sponsored by Meadville/Lombard Theological School and the local church social concerns committee members. I am working on examples that might help fill this gap.

I am also examining some local political committees such as the Citizens Committee for Councilmanic Districting in San Jose, and the Citizens for Representative Government in San Francisco. Both of these committees are working for more representative city councils or boards of supervisors. Computation of the communication entropy of the probable representation of the people of a city for different methods of defining election districts may help determine which alternative method is more democratic.

Recently I visited RESOURCE ONE, The San Francisco Bay Area Community Computer Center, 1380 Howard St., San Francisco, Calif. This non-profit community group has a time-sharing computer system. They are working on projects which they hope will give the people, especially poor and minority people, access to a powerful technology. RESOURCE ONE is organized as a work collective of people from all over the San Francisco Bay Area. Some of the members are living at ONE, a community of 200 artists, craftsmen, technicians and ex-professionals living, working, and sharing their skills in a 5-story converted warehouse in San Francisco.

Another local project that I am following is the Artificial Intelligence Delphi-Forecasting Project of the Systems, Man, and Cybernetics Society. The group is circulating questionnaires to members with questions on twenty-one different potential devices of the future such as talking typewriters, automatic language translators, mobile robots, computer psychiatrists, computer arbiters, insightful economic models, etc. They are compiling probability distributions of the predictions of when such devices might be feasible and also the potential social consequences. The SMC Society is a group in the

Institute of Electrical and Electronic Engineers(IEEE) and is cooperating with the World Future Society and other organizations in this survey.

I am still active in the Society for General Systems Research. I attended a regional planning meeting for the September 1973 Conference in Southern California. The committee is planning to structure the conference as a series of workshops instead of having formal papers. It is felt that more progress can be made under this format in developing common definitions and integrating different approaches to general systems theory.

In January, I attended the Picture Coding Symposium at University of Southern California and the Computer-Communications Conference at California State University, San Jose. A two page abstract of my paper at the Computer-Communications Conference in included in this issue of CTCM as Section 2.5.4.

In this issue of CTCM, Section 1.3.1, Problems of the Semantic Level lays a base for further studies relating work on the technical, semantic, and effective levels of communication theory. Section 1.3.2: Glossary starts a much needed series of definitions in this series. The definition of the word "syzgy" in the glossary is that used by astronomers. In CTCM I/9(File 150) I extended the useage of "syzygy" to apply to the juxtaposition of three or more disturbing social forces in a sociological system. I have recently learned that some Jungian psychologists use the term "syzygy" in still another way. The Jungian use of syzygy refers to the feminine in man (the animua) and the masculine in woman (the animus). Jung saw the Syzygy as the gate to the deeper unconscious which persons must go through on their way to wholeness.

The chart for testing hypotheses in Section 3.0.0 represents a method projected to be similar to the type of charts used by Prof. Panofsky in physics for illustrating how we test hypotheses like the special theory of relativity. Group's I, II, & III correspond to the Force, Power, and Communication Eras, and also correspond less rigorously to the Consciousness I, II, & III people in Reich's Greening of America.

The material on axioms and hypotheses in Sec's 3.0.4 & .5 was developed in the course of discussing possible ways to get feedback from people in the American Society for Cybernetics. It is thought that the structuring of these specific statements may make it easier for people to express approval or disapproval of my theories.

Frederick B. Wood

There are two reasons for writing this section, namely (1) to follow the tradition established in 1949 by Dr. Warren Weaver in his commentary on the reprint in book form of Claude Shannon's Bell System Technical Journal articles on "The Mathematical Theory of Communication," and (2) to respond to letters from readers of COMMUNICATION THEORY in the CAUSE of MAN, such as Question #17(CTCM II/1, p. 26 or File No. 396, p. 10), where the reader complains about many of the words used in CTCM not being in ordinary dictionaries. I shall defer the definitions to Section 1.3.2.

To explain the three levels of communication theory in which semantics is one level, I shall reproduce here an old memorandum of mine written in 1957. This memorandum is still valid except for one comment on the energy needs of our civilization. In the text that follows, the statement that requires revision appears in "strike-out" type, and is followed by a footnote indicating how it should be revised.

COMMUNICATION THEORY IN PERSPECTIVE *

Abstract

The problem of communication and control is the central problem of contemporary society. The concentration of the philosopher upon precision of measurement and precision of definition, although essential for scientific process, tends to neglect human feelings, so that we can lose our humanity. The three levels of communication theory; namely, the technical, the semantic, and the effective must all be developed to maximize the negentropy of human civilization. The confusion between "myths", facts", and "truth" must be properly understood. The relationship between facts, logical truth, and myths must be investigated, particularly as they relate to thermodynamics, information, organization, and reverence for life.

* SEPR Archives No. 17-A.

COMMUNICATION THEORY IN PERSPECTIVE

(Communication Theory and Society)

A. Introduction

This memorandum is an attempt to establish a perspective view of the potential role of the communications research and its philosophical relationship to the problems of contemporary society. The problem of communication and control with maximum individual freedom is the central problem of our civilization. ~~The drive for sufficient energy sources is presently solved.~~(X) As our civilization becomes more complex and interdependent the right of the individual to pursue his own development becomes both more dependent upon large power groups and potentially more unique on account of greater store of scientific and artistic tools available in an industrial society.

B. The Changing Role of Applied Scientific Research in a Complex Society.

It is postulated that the transition from an agricultural society to a highly industrialized society shifts the integrative role of the philosopher into the area of applied research by (1) the increasing specialization of science, (2) the position of applied research as a buffer between basic scientific research and the society which uses the results of science through engineering, and (3) the preoccupation of many philosophers with segments of human activity which can be precisely defined.

X. See note at end of section on how this statement written in 1957 should be revised in 1973.

These changes leave the philosopher unprepared to perceive the totality of human activity. The concentration upon precision of measurement and precision of definition leads to neglect of the interaction of human feelings with the intellectual achievements of science.

C. Understanding of Relation to Society and Levels of Communication Theory.

It is proposed that the creativity of applied research can be increased if there is an understanding of the role of the researcher in the evolving civilization to which he belongs. To approach this problem, let us examine the levels of communication theory postulated by Warren Weaver.[1]

(1) Technical (Engineering) Level of Communication thru Mathematical Theory of Communication of bits of information, i.e., How precisely can the symbols be transmitted?

(2) Semantic Level of Communication Theory. The analysis of the meaning and logic of symbols. How precisely do the transmitted symbols convey the desired meaning?

(3) Effective Level of Communication Theory. The problem of effectiveness of communication. How effectively do the received symbols affect conduct in the desired way.

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[1]Shannon and Weaver, A Mathematical Theory of Communication, pp. 96, 114, University of Illinois Press (1949).

The three levels of communication theory can be further related to types of information as follows:

> Technical information transmission of facts (observed events and generalized laws deduced or verified from series of observed events).
>
> Semantic Information--Determination of logical truth (logical truth, based on set of definitions, defined logical operations, and sentences).
>
> Effective Information--Inciting to action (myths or allegories which effect a sharing of human emotion through the associated access to common human feelings).

There is some doubt as to whether this grouping of "logical truth" with "semantic information" is a valid relationship. Perhaps a more complex table should be constructed showing the relationship of "facts" "logic (truth)" to produce "myths" having a high probability of validity. Thus myths which we can show consistent with known facts by use of logical operations come to be accepted as scientific laws until new facts are discovered which show inconsistancies.

The term "myth" does not imply lack of validity compared to "truth" or "facts". A myth is not intended to be interpreted literally by dictionary definitions of the component words, but conveys a meaning in terms of human feelings that are

not easily communicated verbally.

In the technical information area of communication theory (or cybernetics) the areas of interest are: (1) Theory of information content, (2) Inverse feedback circuits, and (3) Composite networks using inverse feedback circuits as sub-elements.

D. Facts, Logical Truth, and Myths.

As an example of the interrelation of "facts", "logical truth," and "myths" consider the relationship between:

(1) The second law of thermodynamics

(2) The basic definition of information

(3) The equivalence of "information (or authentical)" and negative entropy.

(4) The principle of organization as the message or the life process by which man increases his level of organization (or negative entropy) as an island in the general stream of increasing entropy.[4]

(5) The principle "that all men are created equal."[5]

(6) The principle of "reverence for life."[6]

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[4]See especially Norbert Wiener, The Human Use of Human Beings, (Cybernetics and Society) Second Edition. Garden City, N.Y., Doubleday Anchor Books (1956) p. 95.

[5]Declaration of Independence.

[6]Albert Schweitzer

E. Consciousness of the Communication Problem

The consciousness of the communication problem in our society comes through two channels:

(1) Economic channels in which business organizations find that communications problems must be solved in order to decrease losses or increase profits. The complexity and large size of business and transportation organizations require new solutions of communications problem.

(2) Ideological channels in which human beings are searching for ways to fulfill their potential individuality, while at the same time striving for a higher level of cooperation in a complex industrial society. The pressures for conformity and the insecurity derived from the oscillations in the economic system in the past generate feelings of insecurity. In the past people have responded to these challenges in various ways, such as placing hope in education, communication,[6] social service, and political reform movements.

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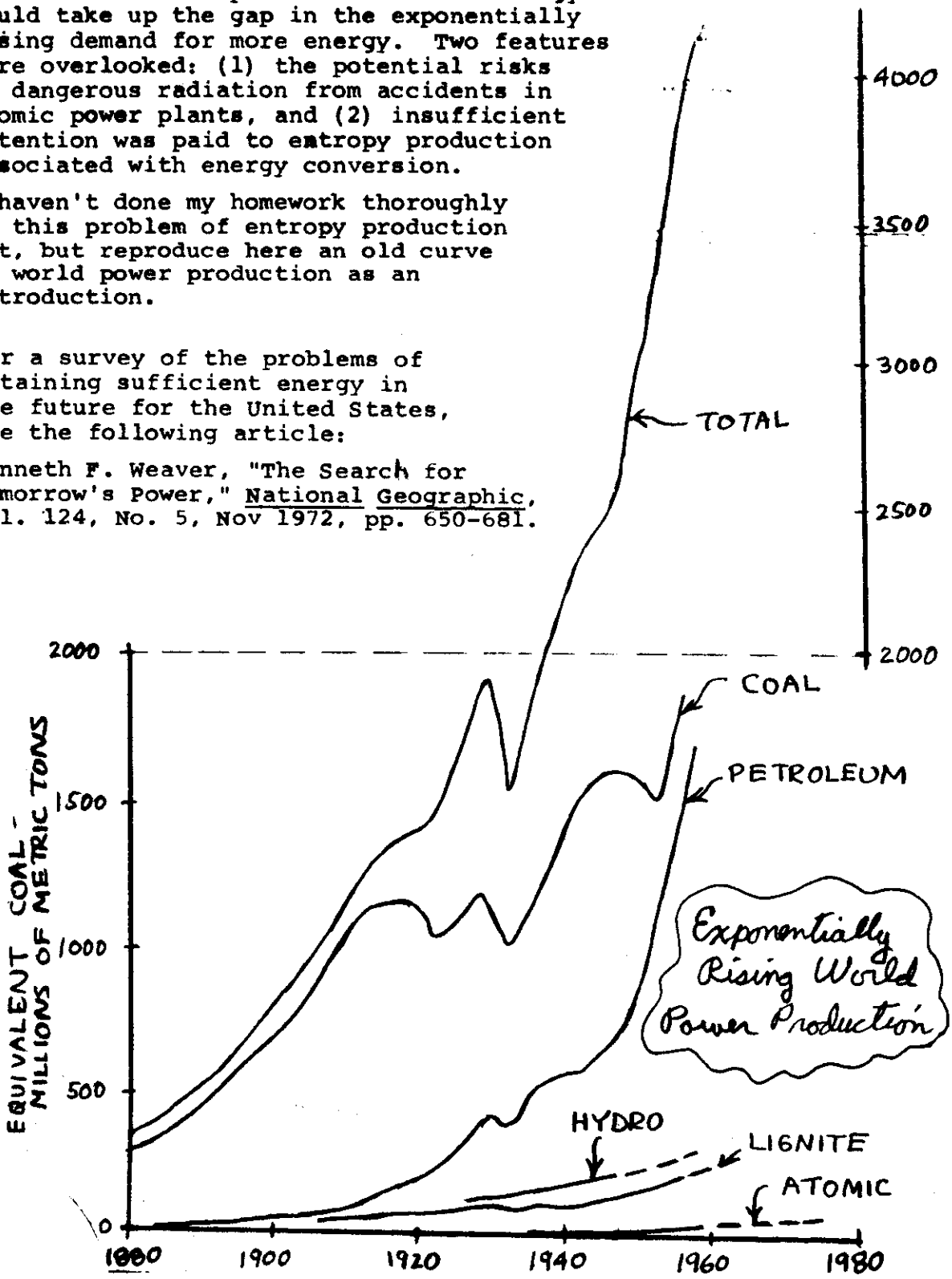
[6]John Mills, The Engineer In Society. N.Y., D. Van Nostrand Co. Inc., (1946).

X - My 1957 statement: "The drive for sufficient energy sources is presently solved." was based on the assumption that atomic energy would take up the gap in the exponentially rising demand for more energy. Two features were overlooked: (1) the potential risks of dangerous radiation from accidents in atomic power plants, and (2) insufficient attention was paid to entropy production associated with energy conversion.

I haven't done my homework thoroughly on this problem of entropy production yet, but reproduce here an old curve of world power production as an introduction.

For a survey of the problems of obtaining sufficient energy in the future for the United States, see the following article:

Kenneth F. Weaver, "The Search for Tomorrow's Power," National Geographic, Vol. 124, No. 5, Nov 1972, pp. 650-681.



The National Geographic article describes our present uses, sources, and efficiencies of the energy sector of the U.S. economy, and reviews the potential future sources of additional energy. A summary of the use of energy in the U.S. is as follows:

Generation and Transmission of Electricity:	17.0%
Residential and commercial lighting, heating, cooking, air conditioning, and electrical appliances:	23.2%
Mining, smelting, manufacturing, and other industrial processes:	27.8%
Fuel for 93 million cars, 185,000 planes, plus ships, boats, trucks, buses, tractors, and other vehicles:	24.1%
Petrochemicals; raw materials for plastics, paints, man-made fibers, and other products:	5.6%
Export:	2.3%

Although the article does give the efficiency of use of energy as about 50%, the emphasis is upon finding additional sources of energy to meet the exponentially rising demand for energy. Now there are two approaches to making more efficient use the present energy resources.

(1) The first is to compute the entropy(physical) production associated with the processes using energy in an effort to pick alternative energy conversion processes that produce less physical entropy.

(2) The second is to examine how much of the 24.1% of the energy used for transportation is really used for processing information(or really for increasing the communication entropy) and could be reduced by substituting computer-communication systems in place of transportation systems.

A number of the words used in the series CTCM has different shades of meaning in different fields of science and in different countries. The most general definitions are given here in Book One of COMMUNICATION THEORY in the CAUSE of MAN. Finer technical differences are to be explained in the glossaries planned for inclusion in Books Two and Three.

Where there are different definitions, the definition closest to the primary one in Webster's Seventh Intercollegiate Dictionary is used here. If the word is not yet included in the dictionary, the definition used by the principal scientific or engineering society is used.

biosphere:
/the part of the world in which life can exist;
/living beings together with their environment

communication theory:
/(technical) the theory of the technology of transmission of information
/(semantic) the theory of the process by which meanings are exchanged between individuals through a common system of symbols
/(effective) the theory of the technique for expressing ideas effectively so as to incite people to action

cybernetics:
/comparative study of the automatic control system formed by the nervous system and the brain and by mechanical-electrical communication systems

entropy:
/a measure of the unavailable energy in a closed thermodynamic system so related to the state of the system that a change in the measure varies with change in the ration of the increment of heat taken in to the absolute tempreature at which it is absorbed;
/a measure of the disorder of a closed thermodynamic system in terms of constant multiple of the natural logarithm of the probability of the occurrence of a particular molecular arrangement of the system that by suitable choice of a constant reduces to the measure of unavailable energy;
/a measure of the amount of information in a message that is based on the logarithm of the number of possible equivalent messages;
/the degration of the matter and energy in the universe to an ultimate state of heat uniformity

feedback:
/the return to the input of a part of the output of a machine, system, or process

general systems theory:
/a general science of'wholeness' which up till now was considered a vague, hazy, and semi-metaphysical concept; in elaborate form it would be a logico-mathematical discipline, in itself purely formal but applicable to the various empirical sciences

homeostasis:
/a relatively stable state of equilibrium or a tendency toward such a state between the different but interdependent elements or groups of elements of an organism or group

information theory:
/a theory that deals statistically with the efficiency of processes of communication between man and machines(as in telecommunication or in computing machines)

negentropy or negative entropy:
/a measure of the average number of bits of information in messages on a communication system which convey information not already known to the receiver

noösphere:
/a stage of development of the biosphere in which mankind taken as a whole is becoming a mighty geological force, in which there arises the problem of the reconstruction of the biosphere in the interests of freely thinking humanity as a single totality. (adapted from W. I. Vernadsky, Academy of Sciences, U.S.S.R, Amer. Scientist, 33:1, p. 10fn, Jan. 1945)

simulation:
/a mathematical model of the principal variables and their interaction of a system that is programmed on an electronic computer to predict the probable behavior of the system by computing the step by step changes and interactions on a computer.

system:
/a regularly interacting or interdependent group of items forming a unified whole

syzygy:
/the nearly straight-line configuration of three celestial bodies (as the sun, moon, and earth during a solar or lunar eclipse) in a gravitational system

thermodynamic imperative:
/a principle proposed by R. B. Lindsay as a candidate for use as an ethical principle in the age of cybernetics, in which one should strive to increase the negative entropy in the universe

Section 2.5.4: Sociological Spin-Off.

Sociological Spin-Off from
Computer-Communications
Systems Engineering
by
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The work reported in this paper is a special type of spin-off from engineering work that requires a long preparation to have the proper multidisciplinary background. The preparatory stages of this work go back to 1932, when I was a student in junior high school. I was puzzled by the empirical fact that the most advanced countries in regard to the development of the arts, literature, and science disintegrate after a certain period of development. I was concerned by the apparent contradiction of the countries which produced a series of great artists, writers, and scientists eventually falling into a state of barbarism.

I tried to see if this process was similar to the rise and fall of ancient Greece and Rome. The social scientists of the depression era could not provide satisfactory answers to my questions. In high school, I concluded that the process of application of science to practical problems was central to this problem. I further concluded that the social scientists were too far removed from the scene of the application of new technology to be able to observe the critical events of such developments.

I concluded that electrical engineering was the optimum profession to be in for the observation of significant features of the interaction of new technology in society. Therefore I changed my plans from a major in one of the social sciences to go to engineering school. Also I felt that the social sciences were more mythology than science. I needed to keep close to the physical sciences and mathematics where there is a tradition of rigorous testing of hypotheses.

While studying electrical engineering in college, I found it difficult to get the needed knowledge of sociology. However, I found a way outside the formal organization of the university. By attending discussions and forums at the University YMCA and the Student YWCA, I got to hear current reports on developments in most of the social sciences. Also I obtained information on the critical problems of our civilization from meetings at Hillel Foundation, Newman Club, and the Unitarian Church.

Further stages of preparation for this work were developed during my engineering work at the MIT Radiation Laboratory (1941-1945) on microwave RADAR. While doing engineering work on weekdays, I explored philosophical problems on Sundays at the Arlington Street Church (Unitarian) in Boston. This led to the base for the sociological equivalent of a mathematical completeness theorem.

After World War II, I pursued graduate study at Berkeley. I developed a special technique for studying the graduate mathematics courses needed in electrical engineering. After each lecture in mathematics, I would go for a hike in the hills to meditate about the material covered in the math lecture. I would think about the material from three viewpoints:

(1) abstract mathematic concepts;
(2) representation of engineering structures;
(3) representation of elements of biological and sociological systems.

My background of sociological information plus this triple approach to mathematics led to a process which I call "technological meditation."

While working in the computer industry on computer-communication systems, this process of "technological meditation" has led to five major spin-offs. These concepts are not claimed as new discoveries, but are perceived as forms of known principles which are easier to implement in connection with the application to real social systems:

(1) Sociological equivalent of the uncertainty principle (physics);
(2) Sociological equivalent of a completeness theorem (mathematics & general systems theory);
(3) Negative feedback systems in political and social systems equivalent to negative feedback amplifiers (electronics & cybernetics);
(4) Concept of image compression in political ideology from electrical communication channel capacity and data compression (information theory);
(5) Concept of maximizing communication entropy in social systems derived from maximizing the entropy of a set of messages on a telegraph system (information theory).

The formulation of the above principles has been defined more precisely while continuing to work on computer-communication systems in the daytime, and teaching an evening course in Cybernetic Systems.

A brief statement of the five principles will be given, followed by a comparison of the fifth one with another derivation of the same principle: This concept of maximizing the communication entropy with R. B. Lindsay's "Thermodynamic Imperative."

Then two examples of the use of this concept are given. The first is an analysis of a hypothetical public opinion survey simulated for conditions in Nazi Germany of 1942. The second is a comparison of six hypothetical countries, in which the calculation of the communication entropy is used to rate where the six countries should be placed on an evolutionary scale as a measure of how advanced they are in terms of the evolution of human civilization. (Fig. 1)

The Code of Ethics of the National Society of Professional Engineers has been carefully followed in these studies to insure that the general abstractions pertinent to the public interest are made accessible, while at the same time proprietary details belonging to engineering corporations are kept confidential.

Negentropy of Probability Distribution of Human Freedom as Measure of Degree of Democracy in a Social System:

These calculations based on estimated probabilities of the following freedoms:

Freedom of speech, Freedom of religion, Freedom to publish, Freedom to find Freedom to obtain sexual partner, education, Freedom to build home, Right to vote, Right to trial by jury Freedom from job discrimination on account of race, Freedom to establish a small business or farm.

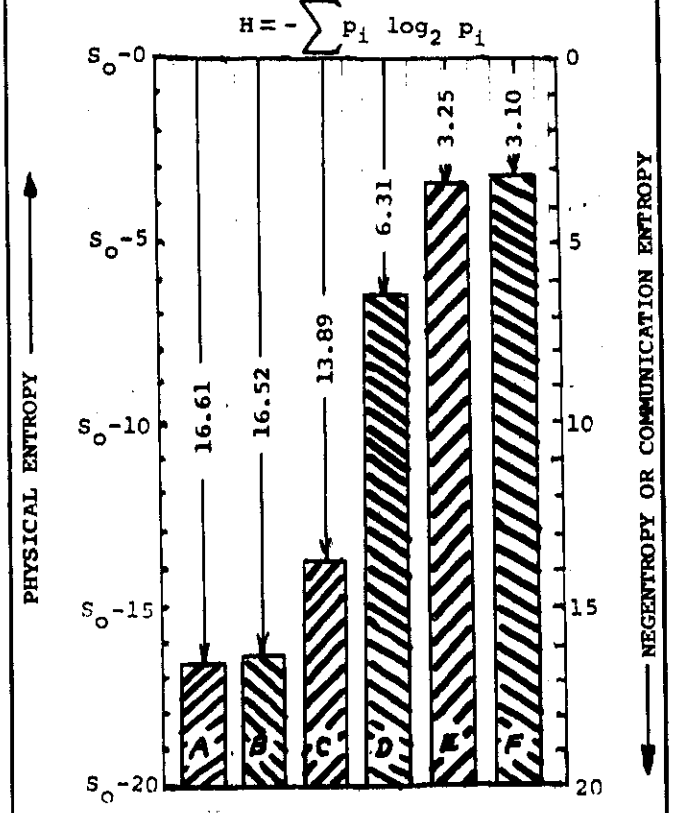


Fig. 1 - Comparison of Entropies of City States of 100,000 Population for Cases:
(A) Ideal Democracy (B) Democracy
(C) Partial Democracy (D) Oligarchy
(E) Caste System (F) Dictatorship

DEFINITIONS & REFERENCES

Technological Meditation: A subconscious process of correlation between the engineering technology and systems upon which an engineer is working with the sociological system within which the engineer is working.

Refs: COMMUNICATION THEORY in the CAUSE of MAN (Abbreviated CTCM), v. I, n. 1-2, pp. 19-21, Jun-July 1970.
CTCM, v. I, n. 12, p. 6, Jun 1971.

Sociological Uncertainty Principle: There is a limit to the preciseness of observation of the evolution of a social system, similar to the limit on the observation of physical systems set by the uncertainty principle and Planck's constant.

Refs: CTCM, v. I, n. 7-8, p. 16, Jan-Feb 1971

Equivalent Completeness Theorem for Sociological Systems: Since it is not possible to formulate a quantitative completeness theorem for the mathematical representation of biological and social systems, a checking chart is proposed as a qualitative equivalent to insure minimum probability of overlooking important factors.

Refs: F. B. Wood, "The Social Responsibility of Engineers and Scientists," 1959 Proc Western Joint Computer Conf., Mar 1959, pp. 310-313.
CTCM, v. I, n. 9, Mar 1971, pp. 14-16.
CTCM, v. II, n. 1, Jul-Sep 1971, pp. 8-9.

Socio-Engineering Problems Report (SEPR) No. 402-A, Oct. 30, 1972

Negative Feedback in Social Systems: A social system in which output information is coupled back into the input in such a way to cancel part of the input in order to maintain the social system at some desired stable level of functioning.

Ref: CTCM, v. I, n. 5-6, Nov-Dec 1970, pp. 8-10.

Image Compression in Social Systems: Political ideology consists of a kind of image compression accompanied by a significant loss of information, similar to compression of facsimile or computer digital data where the loss of information prevents accurate reconstruction of the original information.

Engin. Ref: P. D. Dodd and F. B. Wood, "Image Information, Classification and Coding," 1966 IEEE Intern. Conv. Record, Part 7, pp. 60-71.

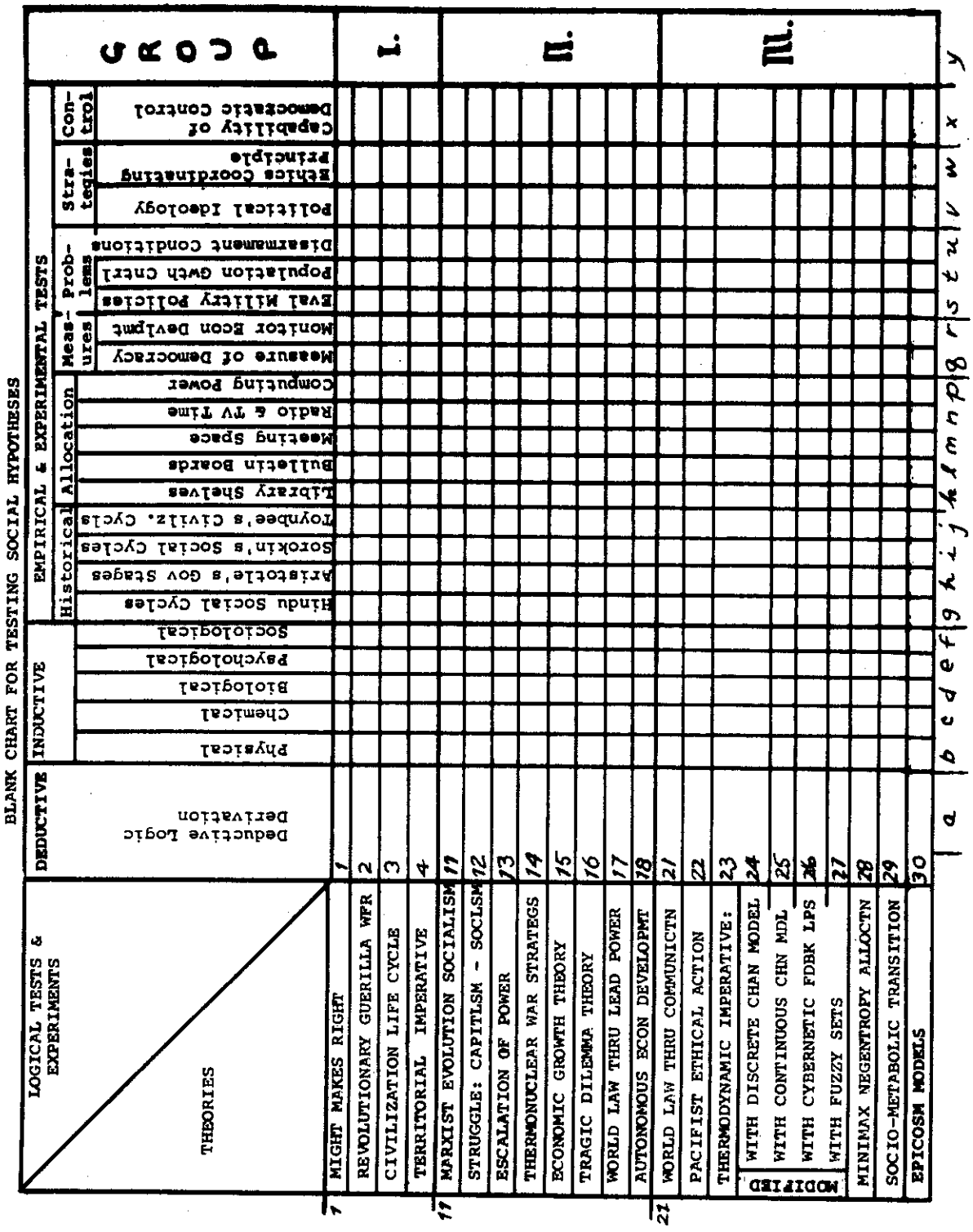
Socio Ref: CTCM, v. I, n. 1-2, Jun-July 1970; pp. 19-20.

Maximizing Communication Entropy in Social Systems: The equivalent of Shannon's discrete channel model can be used to measure the communication entropy of a social system. The higher the communication entropy (or negentropy) the more democratic the society is, provided a set of fifteen other parameters can be assumed to remain constant. More complete information on social systems can be developed by using other models such as the continuous channel model.

Refs: Conference Paper (preprint only) for First International Congress of Social Psychiatry, London, August 1964, "A General Systems Theoretic Model for the Estimation of the Negentropy of Sociological Systems through the Application of Two Isomorphic Electrical Communication Networks." (Main points have been reprinted in CTCM, v. II, nos. 1 & 2, Jul-Sep 1971 & Oct-Dec 1971)

Discussion in The Evolving Society, edited by Alice Mary Hilton, N.Y.: ICR Press, 225 East 23rd St., N.Y. 10021 (1966), pp. 227-229.

Letter to the editor, Society for Social Responsibility in Science Newsletter, No. 195, Jan 1969, 221 Rock Hill Ave., Bala Cynwyd, PA 19004. Discussion in SSRS Newsletter, No. 203, Oct-Dec 1969. Rejoinder in CTCM, v. I, n. 3-4, Aug-Sep 1970, pp. 18-22.



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The following axioms have been assumed in the research upon which this series of studies is based. An "axiom" is defined as "a proposition regarded as a self-evident truth."

Axiom A: The researcher is himself a part of the multidisciplinary study; and hence there is a certain amount of uncertainty, because in behavioral science it is difficult to isolate the observer from the subjects of the experiments. Therefore the researcher needs some review of what role he is in to determine under what limitations he is functioning at a given time.

Axiom B: The researcher at the intersection of psychological phenomena and sociological phenomena, unlike the physical scientist, cannot separate himself from the social process. Hence he needs an historical perspective against which to evaluate his own growth in respect to the main streams of civilization in time.

Axiom C: In addition to the time perspective of the development of human civilization, some measure of the part of human knowledge being covered by a particular researcher is needed as a space perspective to help the researcher orient his own multidisciplinary work to the interdisciplinary work of the group to which he belongs.

Axiom D: The procedural method in utilizing concepts like "negentropy" in General Systems Theory will be to establish plausible hypotheses concerning systems isomorphic between different levels of phenomena through use of all viewpoints implied by the axioms A, B, & C and then cooperatively testing the working hypotheses.

The following hypotheses have been developed in the process of this research project. A "hypothesis" is defined as "a tentative assumption made in order to draw out and test its logical or empirical consequences." Other hypotheses have been formulated, but were dropped when evidence accumulated which showed them to be invalid.

Hypothesis 1: The negentropy of a sociological system can be approximated by calculating the negentropy of a set of messages that might be sent over an equivalent pair of wires such that the sociological system corresponds to the discrete communication channel in Information Theory, in which case the set of human freedoms in the sociological systems correspond to the set of messages sent over the isomorphic electrical communication network.

Hypothesis 2: The negentropy of the probability distribution of political ideas in a sociological system can be approximated by the negentropy of the message distribution on a telephone cable for the continuous channel with limited average power. The assumed scale of political ideas is taken as a "measure of collective direction" or MCD. The resultant negentropy is considered as a measure of "dynamic-justice" -- a balance between maximizing democracy and maximizing organization to keep the system stable. The telephone cable pair is considered isomorphic to the sociological system, when the limiting average power in the cable is considered equivalent to the per capita power production in the sociological system.

A table of testing these hypotheses is included on the next page.

TESTS / HYPOTHESES	Do Hypotheses Give Reasonable Values For: Ideal Democracy	Class Discrimination	Caste System	Dictatorship	Function of Population	Do Models Allow for Different Evolving Paths?	Does it Give a Good Static Measure?	Does it Include Stability?	Does it Permit Substitution of New Functions?
Hypotheses One "Democracy" & Negentropy (Discrete Chan.) Noiseless	Yes	Yes	?	Yes	Yes	Yes	Yes	No	
Hypotheses Two "Dynamic-Justice" Max. Negentropy (Cont. Channel Power Limited)	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes

Hypothesis 3: Certain critical problems involved in the ability of a mass society to survive are more likely to be perceived by engineers than by sociologists. This is possible due to the occurrence of a process identified as "technological meditation," which is a subconscious process of correlation between the engineering technology and systems upon which an engineer is working with the sociological system within which the engineer is working.

Hypothesis 4: There is a limit to the preciseness of observation of the evolution of a social system, similar to the limit on the observation of physical systems set by the uncertainty principle and Planck's constant. This indicates it is possible to organize social change that traditional sociological theory would label as impossible. Some sociologists say that most powerful social systems do not allow social scientists to critically examine the social system. This sociological uncertainty principle says that there is a certain amount of resistance to social research, but it is finite like the limitation on measurements in physics set by Planck's constant.

Hypothesis 5: Since it is not possible to formulate a quantitive completeness theorem for the mathematical representation of biological and social systems, a checking chart is proposed as a qualitative equivalent to insure minimum probability of overlooking important factors.

Hypothesis 6: An important factor in the stability of social systems is the existence of negative feedback in which output information is coupled back into the input in such a way as to cancel part of the input in order to maintain the social system at some desired stable level of functioning.

Hypothesis 7: Political ideology consists of a kind of image compression accompanied by a significant loss of information, similar to compression of facsimile data or computer digital data where the loss of information prevents accurate reconstruction of the original information.

Hypothesis 1A: Lindsay's thermodynamic imperative corresponds to maximizing communication entropy in social systems. The equivalent of Shannon's discrete channel model can be used to measure the communication entropy of a social system. The higher the communication entropy (or negentropy) the more democratic the society is, provided a set of fifteen other parameters can be assumed to remain constant. More complete information on social systems can be developed by using other models such as the continuous channel model.

Hypothesis 1B: There is a minimax negentropy allocation principle which permits a property owner, large corporation, or government agency having jurisdiction over certain scarce resources to allocate these resources impartially among contesting groups by allocating the resources in proportion to the negentropy of the individual groups relative membership statistics.

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Question 24: Does your analysis fail to take into account an important factor, namely the mobility of people, which contributes significantly to economic and intellectual development? How about the impact of the automobile?

K.C.

Mobility of people is a significant factor, particularly at the period of transition from the Force Era to the Power Era. This factor of mobility has been studied by N. Rashevsky in a number of papers. The following article is of particular significance:

> N. Rashevsky, "Outline of a Mathematical Approach to History," Bulletin of Mathematical Biophysics, Vol. 15, 1953, pp. 197-234.
>
> In early societies the channels of communication were practically identical with the channels of economic transport such as roads and waterways. An equation or expression is developed for the time required for the development of small villages into large cities. This expression is dependent upon the ratio of shoreline to area of the country. This greater specific shoreline of Europe(ten times that of the average for the rest of the world) may account quantitatively for the faster technological and social development of Europe over the last two centuries.

More recently the automobile, jet aircraft, radio, and television have all acted to increase the amount of communication in our world. As we move further into the "communication era" it is probable that we will be able to reduce the amount of physical movement of people and things, by making fuller use of telecommunications.

When refiling the back issues of CTCM to make a loose-leaf book, it is suggested that that the title pages and editorial notes be filed in the back in this section in the order indicated below:

Section	File No. Pages	CTCM No.	
CTCM: TITLE PAGES AND EDITORIAL NOTES FROM INDIVIDUAL ISSUES OF THE MAGAZINE: CTCM.			
Vol. I, No. 1-2, June-July 1970 (8/30/70 Revision of 7/12/70 Vers.)	100-F-7 title-0	I/1-2	1-2
Vol. I, No. 3-4, Aug-Sept 1970 (10/4/70)	100-F-8 title-0	I/3-4	1-2
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Vol. I, No. 5-6, Nov-Dec 1970 (3/28/71) Title p. & acknowledgements	98-F-10 title-2	I/5-6	1-2
Editorial Notes, Letters to the Ed.	99-F-10 5-10	I/5-6	3-5A, 5B-6
Vol. I, No. 7-8, Jan-Feb 1971 (7/4/71) Title p., ackn., copyright	98-F-11 title-4	I/7-8	1-2
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Vol. I, No. 10-11, Apr-May 1971 (9/5/ 71) Title p., list of figs.	99-F-13 title-2Y	I/10-11	1-2
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