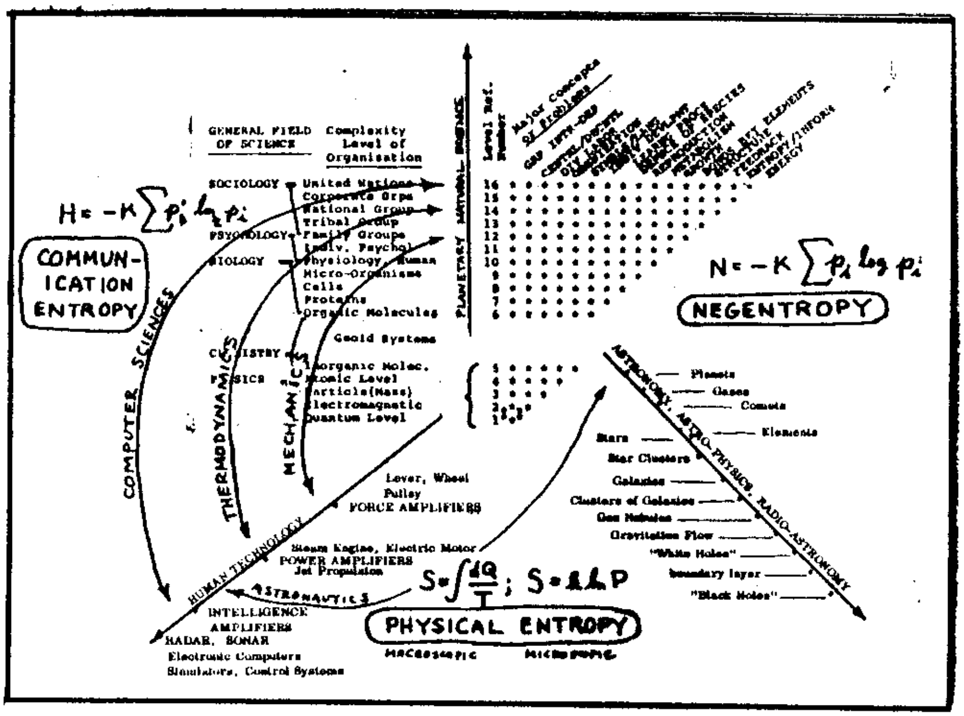
VOL III NO 3

COMMUNICATION THEORY in the CAUSE of MAN

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.

INSIDE THIS ISSUE:

A Proposal For Replacing The "Thermodynamic Imperative" By The "Negentropic Imperative."



Larger Scale Diagram on Page 10 A.

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COMMUNICATION THEORY
in the CAUSE of MAN

P.O. Box 5095, San Jose, California 95150

Frederick Bernard Wood, Editor and Publisher

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Section 3.9.7: Editorial Notes(Continued from Previous Issues)

For a third time various problems have interrupted the publication schedule of this magazine for more than six months. I have studied a number of books on managing small business and some on managing magazine publications and have found that none of these books contain anything relevant to the problems I have encountered. I have found it necessary to learn about the Federal Register in which new government regulations and announcements are published daily, and to follow the Congressional Record to understand what new policies are being formulated by congressional sub-committees.

In addition to delays in the publication schedule caused by external events such as unforseen government regulations, there have been delays caused by my own decisions to learn more about the practical political processes of our country. I felt that it was important to participate in the party caucus for one presidential candidate.

I have also concluded that I need to maintain closer communication with congressmen and state legislators. To achieve this I met with a state senator and a congressman in connection with the COMMON CAUSE legislative program. I also analysed questions being prepared for presentation to the presidential candidates.

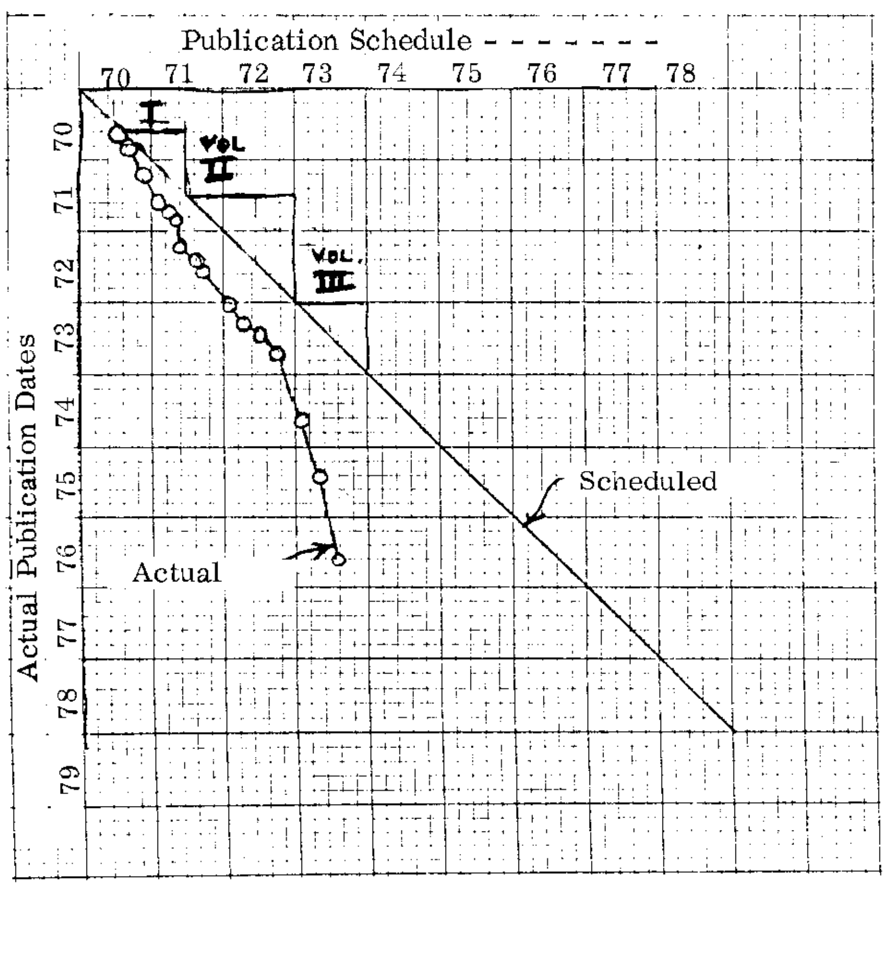
Now these political activities have further delayed the editing and publication of this magazine in addition to the external disturbances. In addition I began to feel that the logical conclusion of extending the hypotheses developed in CTCM so far would be a conflict with the policies being followed by the U.S. Central Intelligence Agency incertain foreign countries such as Chile. The work of the Senate Select Committee to Study Governmental Operations with Respect to Intelligence Activities under the chairmanship of Senator Frank Church has has helped me gain a perspective of covert action by the U.S.A. against Chile during four presidents, namely John F. Kennedy, Lyndon B. Johnson, Richard Nixon, and Gerald R. Ford. There is a good summary in the Staff Report of the above mentioned committee titled "Covert Action In Chile 1963-1973" issued Dec. 18, 1975(U.S. Government Printing Office, Price 80¢)

As I have become more aware of the work of the Trilateral Commission, I have become more concerned over the emphasis on decreasing the degree of democracy found in many of the reports associated with the Trilateral Commission. Some of the proposals made to the Trilateral Commission such as the need for for national planning appear logically appropriate and valid, yet other proposals such as cutting back on education, lowering the job expectations of of college graduates, plus this talk about "governability of democracies" appear to be slanted toward making our civilization less democratically controlled. (See "Are Democracies Governable ?", Wall Street Journal, August 1, 1975, p. 6, col. 4; Alan Wolfe, "Giving Up on Democracy: Capitalism Shows Its Face," Nation, vol. 221, no. 18, Nov. 29, 1975, pp. 557-563).

Since a number of proposals at the Trilateral Commission are contradictory to the concepts being developed in CTCM, namely theorems on maximizing entropy-like properties of social systems, I felt it important to be sure that the theorems developed in CTCM be checked as rigorously as possible. However the development of discussions of quasi-completeness theorems made the publication of CTCM more susceptible to delays from external disturbances. On the graph below, I have plotted the publication schedule of CTCM on the horizontal axis and the actual publication dates on the vertical axis. From this plot it is apparent the rate at which I am getting the magazine published is closer to one issue per year instead of the scheduled four per year.

I intend to makethis issue of CTCM a turning point on the curve such that the next few issues cause the curve to swing back toward the scheduled line on the plot below. Considersing past problems, I am not making any predictions as to actual publications dates. My plan is to defer formal development of the quasi-completeness theorem, and publish fragmentary concepts with corrections in subsequent issues, if errors are made.

Frederick B. Wood
Editor and Publisher



Notes on the Contents of this Issue of CTCM

Due to the long time lapse since the last issue, Section 1.0.0B, "Blue Page" Project Summary is being repeated to give readers a summary of the relationship of the magazine to the book project.

Sec. 1.0.2A: The "Negentropic Imperative." has been prepared as a basis for discussion of how R.B. Lindsay's oversimplified principle of the "Thermodynamic Imperative" can be reformulated to take into account the differences in important "entropy-like " properties of natural physical systems, bio-social systems, and man-made tools and technologies which establish communication between the physical and social systems.

Sec. 1.0.4: Steam Engine and the Macroscopic Concept of Entropy. The purpose of this section is to continue the plan of having a brief review of the different applications of the concept of entropy that was started with Sec. 1.0.3: Heating Systems and the Concept of Entropy. This new section proceeds on to the role of entropy in understanding the conversion of heat energy to mechanical work in the steam engine.

Sec. 2.3.5: Application of Information Theory to Social Systems for Three Boundary Conditions. This section summarizea a paper presented at the International Communications Conference of the Institute of Electrical and Electronic Engineers, San Francisco, California, June 1975. Also a corrected set of curves are provided to replace the sample curves on ideal distribution of income levels.

Sec 3.1.E Completeness Theorems in Mathematics. The purpose of this section is to give us a background on the nature of completeness theorems preparatory to the future discussion of the best equivalent of completeness theorems for the application of cybernetics to social systems.

Notes on the Historical Origins of this Magazine and Book Project.

Some conflicts arise over the role of the magazine CTCM due to lack of information on the historical process throgh which the underlying ideas were developed. To give the reader a perspective I plan in the course of the next few issues of CTCM to give the background of these developments in approximately chronological sequence.

Some of my ancestors were members of the Society of Friends in England during the time of George Fox(1624 -1691), while others joined the Unitarian Church, which followed with some interruptions the leadership of Miguel Serveto, also known as Michael Servetus(1511-1553). Although I have always been interested in standing up for human freedom, I neither have as much courage as George Fox, who spent a large part of his life in and out of jails, nor as Miguel Serveto, who was burned at the stake after the cover was blown on his pseudonym of Dr. Vilanovanus. Following the sociological uncertainty principle, I have tried to maximize my observations and analyses of the social impact of technology and engineering theory without exceeding the bounds for which one gets ejected from the system. Part of the strategy involves working in a large industry and discussing the social impact within church groups.

My career path was planned back in 1935 as I saw the Nazis bringing a country that had led the world in science, art, and literature back to barbarianism. I had been unable to get satisfactory answers to my questions from university social scientists as to why civilization was returning to barbarianism, and as to what the role of developing technology was in this retreat from civilization. I decided that to fight for human freedom, one had to be an engineer or scientist at the interface between science and society where the new technologies were being applied. I changed my plan of studies to major in electrical engineering, where I thought the optimum place would be to understand the impact of new technology.

As World War II developed, I had to temporarily drop my long range plans, to use my engineering knowledge in the short run in developing RADAR at the M.I.T. Radiation Laboratory for the immediate goal of stopping the Nazis, who were the principal agents of the return to barbarianism. In the next few issues I shall continue these brief notes on my career path in respect to the understanding of the social impact of technology.

Frederick B. Wood

Section 1.0.0B: "Blue Page" Project Summary. This "blue page" is included to help the new reader of CTCM who hasn't read the preceding issues to get a perspective of the series.

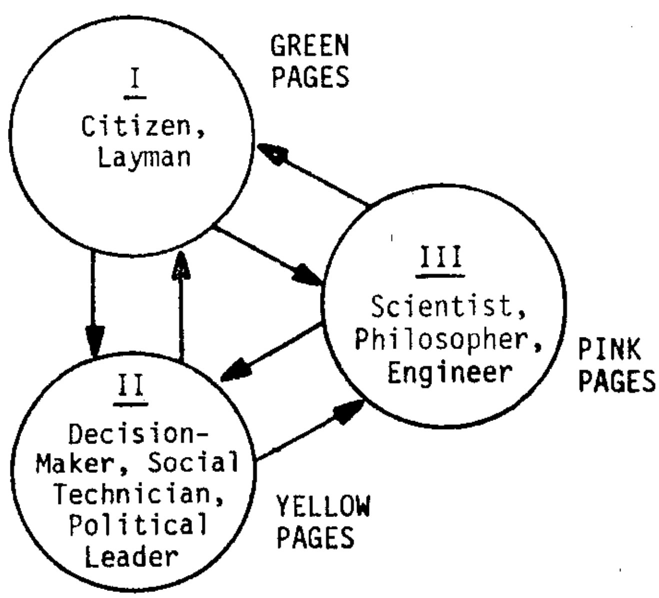
Magazine 'CTCM' Book 'CTCM'

This periodical is scheduled to be published quarterly and is planned so that each issue will constitute a group of sections which update the loose-leaf book, COMMUNICATION THEORY in the CAUSE of MAN. The first public edition of the book was issued in October 1973 and consisted of Volumes I and II of the magazine, CTCM, rearranged in "file number" sequence. The object of both the book and the magazine is to provide some tools from the mathematical and engineering theory of communication, and in particular from Cybernetics and Information Theory, to help the layman find some ideas by which he can more easily determine his course toward a more democratic society.

Each page is labelled with the volume and issue numbers of the magazine, CTCM, and with the "file numbers" of the book. Thus one may rearrange the pages of the cumulated magazine issues by file numbers to put the sections in the order of the loose-leaf book.

Citizen? and/or Decision-Maker? and/or Scientist?

Who is going to benefit from research in General Systems Theory, Cybernetics, and Information Theory? Are these fields of science and engineering going to be used for the benefit of all mankind? Or are they going to be used primarily for the private benefit of particular ruling classes? How do we insure the use of such knowledge in the interests of strengthening democratic institutions? I have an intuitive feeling that to protect the interests of the people, some way must be found to combine general articles, technical applications articles, and basic scientific articles into the same journals and books, while maintaining proper labels as to the nature of the different sections. The three groups of readers are illustrated by the following diagram:



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 <u>CTCM</u>, Vol. II, No. 6-A, pp. 11-21 (Section 1.0.1).

Short Outline of the Proposed Book

COMMUNICATION THEORY in the CAUSE of MAN:

Section 1.0.2A: The "Negentropic Imperative."

The Thermodynamic Imperative of R. B. Lindsay gave us a start on the way to developing a relationship between the physical sciences and optimizing principles (or ethics) of social systems. I anticipated that modifications would have to be made when I first referred to the "Thermodynamic Imperative" in the first issue of the magazine CTCM (Book Section 3.3.0 or Magazine I/1-2, June-July 1970):

> "I think that future historians of science will conclude that Lindsay made an important contribution, but that carrying a concept from physics through chemistry, biology, psychology and sociology requires a number of refinements."

In 1970 when I prepared the first issue of the Magazine CTCM I debated whether to start from the discussions of applying the concept of maximizing the "negentropy" of social systems that had been discussed in a discussion group at the First Unitarian Church of San Jose in 1956-1957 or to start with the first published paper on the subject, namely the paper on "Entropy Consumption and Values in Physical Science," by R. B. Lindsay in American Scientist, September 1959, pp. 376-385. I decided to refer to the published paper by R. B. Lindsay in which he first stated the principle as follows:

> "While we do live we ought always to act in all things in such a way as to produce as much order in our environment as possible, in other words to maximize the consumption of entropy. This is the thermodynamic imperative, a normative principle which may serve as the basis for a persuasive ethic in the spirit of the Golden Rule and Kant's categorical imperative."

Dr. Lindsay presented this concept at a number of conferences and restated it in 1963 in The Role of Science in Civilization (N.Y.: Harper & Row), pp. 290-298.

> "All men should fight as vigorously as possible to increase the degree of order in their environment, i.e., consume as much entropy as possible, in order to combat the natural tendency for entropy to increase and for order in the universe to be transformed into disorder, in accordance with the second law of thermodynamics."

As a result of correspondence received objecting to the above formulation and some sample calculations I made for the negentropy of certain properties of social systems, I proposed the following modification in the Magazine CTCM I/3-4 (Book Sections 2.3.2A & 2.3.2C):

> "All men should fight always as vigorously as possible to optimize the order-diversity balance in their environment, i.e., consume as much

entropy as possible, in order to combat the natural tendency for entropy to increase and for order in the universe to be transformed into disorder, and diversity to be transformed into conformity, in accordance with the second law of thermodynamics."

In the meantime Professor Lindsay continued to state the principle in an over-simplified way, such as the following in "The Larger Cybernetics," in ZYGON June 1971, pp. 126-134:

> "We as individuals should endeavor to consume as much entropy as possible to increase the order in our environment. This is the thermodynamic imperative, possibly not unworthy to rank alongside the categorical imperative of Kant or even the Golden Rule."

Since further objections to the thermodynamic imperative have been received, such as the note by Byron Hale in CTCM III/2, p. 27 (Book Section 3.3.1), I feel it is necessary to develop an equivalent statement that distinguishes between entropy-like properties in three areas: physical systems, social systems, and human-to-machine systems. The nature of these three categories of systems are illustrated in the figure on the next page.

The new extension of the "Thermodynamic Imperative", which I shall call the "Negentropic Imperative" is stated as follows:

> Negentropic Imperative: The developmental potential of present and future generations of human beings on the planet Earth can best be nurtured by choice of decisions which maximize the negentropy of distributions of properties of social systems; which increase the communication entropy of bio-social systems and which use scarce energy and matter in methods which cause the least increase in physical entropy.

The table of hierarchies in Nature and of Man-Made Technologies on the next page displays the general domains of the three entropy-like properties used in the above theorem.

Physical entropy is a measure of the unavailability of energy for useful work in physical systems from the quantum level up through inorganic molecules, and also in the geoid systems of astronomy.

On the macroscopic level, such as in the measurement of of the efficiency of a steam engine, entropy is defined by: where dQ is the heat transferred, and T is the absolute temperature.

$$S = \int \frac{dQ}{T}$$

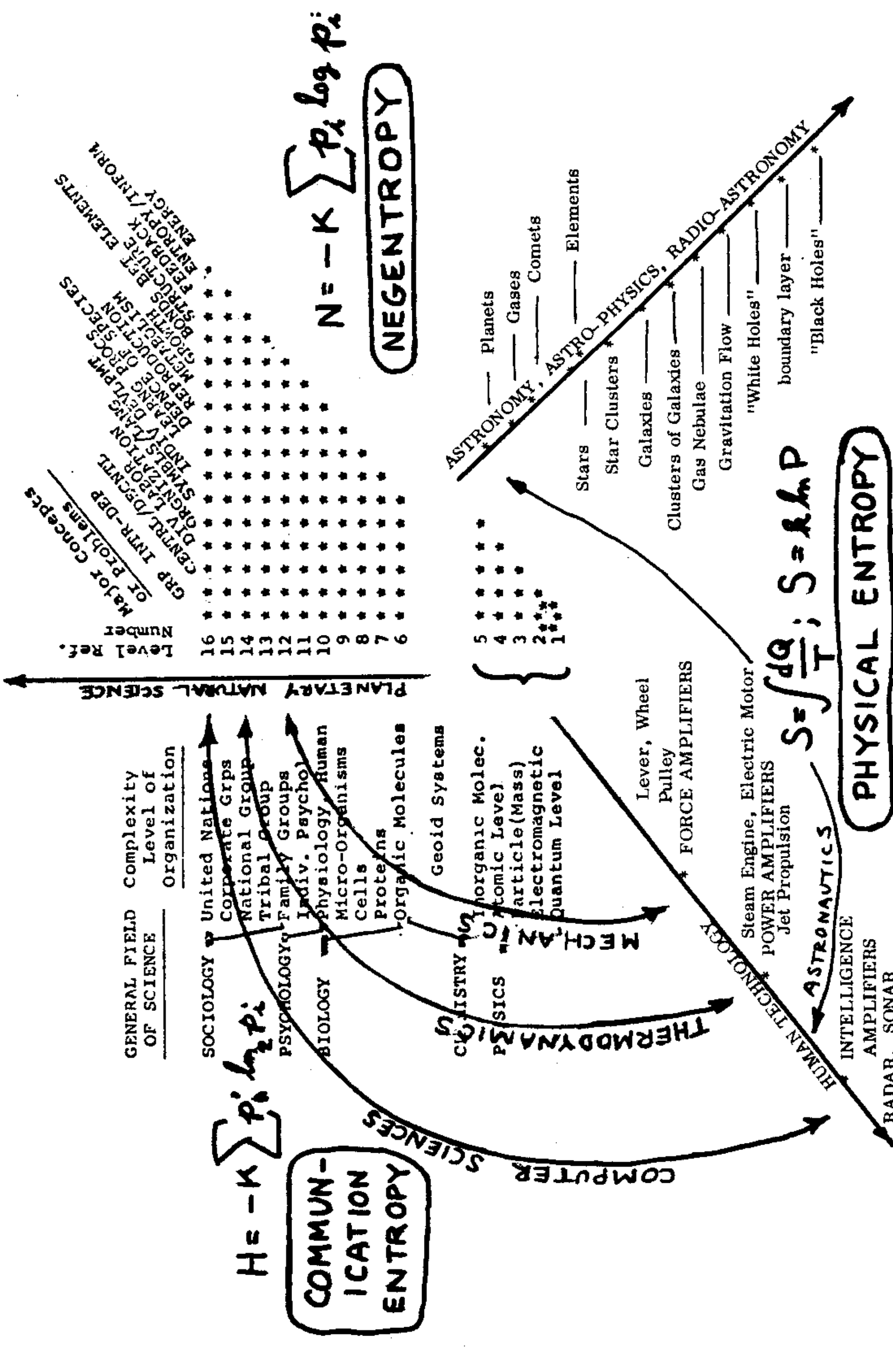


Fig. 1 - Table of Hierarchies in Nature and Man-Made Technologies.

On the microscopic level of accounting for the distributions of individual gas molecules the entropy is defined as:
where k is a constant known as the Boltzmann constant (1.38×10^{-16} ergs per degree C), ln means the natural logarithm, and P is the number of "elementary complexions" or distribution structures that the gas molecules can be in.

$$S = k \ln P$$

Communication entropy is equivalent to the average information transfer in Bio-Social Systems(language, alphabets, etc.) or in Communication Devices (technological artifacts used in communication) and in Telegraph, RADAR, Computer-Communication Systems(codes and instruction sets).

Entropy as defined by Shannon, equivalent to the negentropy defined by Brillouin, and the same as "communication entropy" defined by Fano:
where K is a positive constant, p_i is the probability of occurence of the i-th letter, code, message, or instruction, and $\ln_2$ means the logarithm to the base 2.

$$H = -K \sum p_i \ln_2 p_i$$

In biological and social systems the "negentropy" is a measure of the complexity of the organization of the system. Maximizing the negentropy where the correct boundary conditions are used works toward a more advanced state of development of the biological or social system.

Negentropy as defined by Brillouin is:
where the parameters are the same as in communication entropy. Negentropy (N) is here defined as the negative of the entropy(S). Note that here the negentropy in the same formula as the communication entropy used in engineering.

$$N = -K \sum p_i \log p_i$$

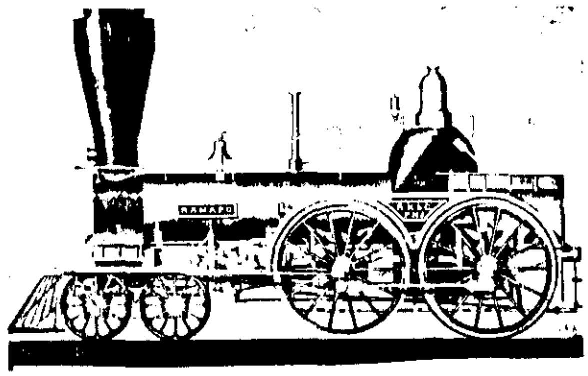
$$N = -S$$

$$S = +K \sum p_i \log p_i$$

There is not yet general agreement among scientists on the extension of concepts of entropy-like properties to social systems. In fact some scientists have coined new names such as "ectropy" and "syntropy" for certain entropy-like properties of social systems. We plan to examine such special definitions in future issues of <u>CTCM</u>.

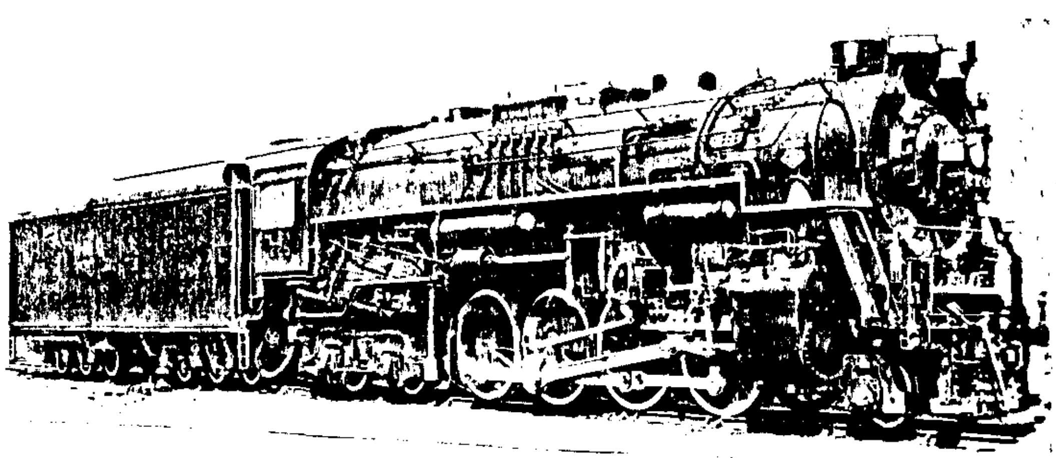
A bibliography of references is tabulated in Section 3.9.1 on pages 22A through 22E of this issue of <u>CTCM</u>.

Section 1.0.4: Steam Engine and the Macroscopic Systems Concept of Entropy.



To understand the proper application of 'entropy-like' properties to physical, chemical, biological, psychological and social systems, it is first desirable to have an understanding of how the concept of "entropy" was first applied. The concept of entropy was developed by Clausius in 1850 in which he synthesized the work of Mayer, Joule, and Helmholtz with that of Carnot and Claperyron to form a well organized theory of thermodynamics.

The concept of entropy was very useful in aiding engineers and scientists in the development of an understanding of the working of the steam engines of that era. Particularly Carnot's concept of an ideal engine cycle gave the engineers a limit in the way of an ideal efficiency for a steam engine working between two temperatures. On the next two pages we will outline the working cycle of an elementary steam engine based upon the Rankine cycle and compare it with an ideal Carnot cycle.

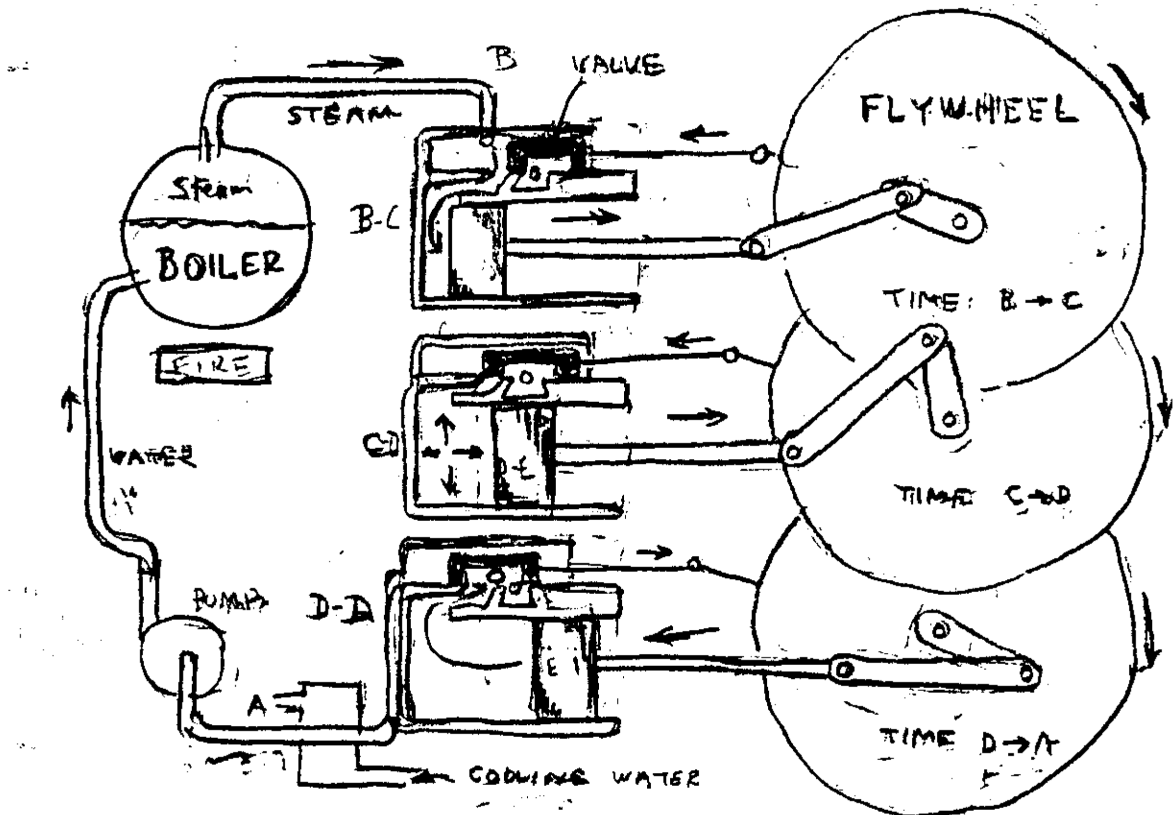


Operation of a Steam Engine:

The diagram on the previous page illustrates the basic operation of a steam engine. Below the functional diagram are two sets of graphs of the cycling of the water-steam system. The Rankine Cycle represents a practically realizable steam engine. The Carnot Cycle is an ideal system that illustrates the operation of an ideal steam engine. In these two sets of graphs the pressure vs. volume graphs are directly measurable by simple instrucments that can be mounted on the steam engine piston and cylinder. The second set of graphs, namely the temperature vs. entropy graphs, indicate more clearly the efficiency of the steam engine. However the parameter "entropy" must be computed from the sum of the incremental gains and losses of heat by the steam divided by the the instantaneous values of the absolute temperature of the steam.

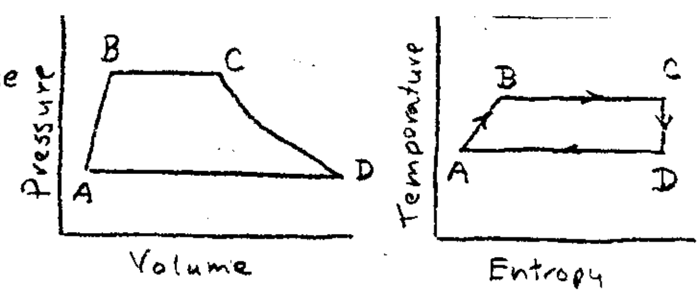
Cycle Step	Function
A - B	The pressure and temperature of the water is raised by the pump and heat under the boiler.
B - C	The valve opens, letting the steam enter the cylinder to push the piston to the fight.
C - D	When the piston has moved approximately halfway the valve closes. The steam expands, doing more work on the piston, and decreases in temperature due to the transfer of energy to the piston.
D - A	At the end of the travel of the piston, the valve opens to exhaust port so that as the flywheel moves the piston back, the piston forces the steam out the exhaust port to the cooling water condenser and to the pump to repeat the cycle.

Magazine III/3, p. 14 is blank.

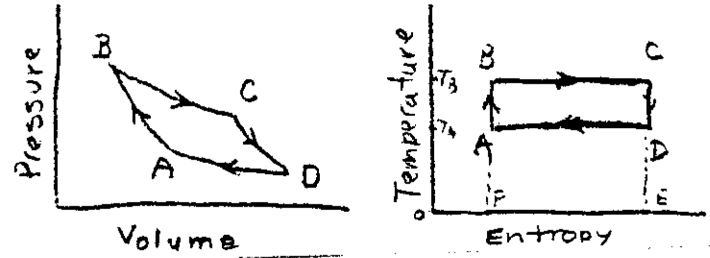


STEAM ENGINE

Rankine Cycle



Carnot Cycle (Ideal)



Section 2.3.5: Application of Information Theory to Social Systems for Three Boundary Conditions.

This section is a summary of a paper given at the Institute of Electrical And Electronic Engineers International Communications Conference, San Francisco, June 1975 as "Some Social Implications of the Mathematical Theory of Communications."

ABSTRACT

The empirical correlation of information input overload phenomena as developed by James G. Miller is reviewed to lay the basis for considering analogies between different levels of communication channels. Then the entropies of alphabets for discrete and continuous channels are discussed. Next the plausible relationships between the different abstract boundary conditions are explored, and the social systems examples are evaluated as a tentative test of the social analog of the mathematical theory of electrical communication channels. These three sets of boundary conditions lead to theories of income distribution, political rights (voting), and distribution of power by political groups in developing countries.

BEHAVIORAL SCIENCE AND INFORMATION THEORY

In 1954 I went to a conference at the Center for the Advanced Study of the Behavioral Sciences, Stanford. At the conference plans were formulated for a scientific society to help develop studies searching for isomorphic relationships of concepts, laws, and models in various fields of science. This organization is now known as the Society for General Systems Research, and became affiliated with Section L of the American Association for the Advancement of Science at the Berkeley meeting in 1954.

One of the leaders of the conference, Dr. James G. Miller, a psychiatrist, and director of the Mental Health Research Institute at University of Michigan, outlined some studies of output rate versus input rate for information passing through different levels of bio-social systems.[3] A set of curves from a later paper of his have been replotted on a set of similar curves for electrical communication channels in Fig. 1. I was impressed by the similarity of these curves to the curves of various electrical communication channels being discussed at conferences on Information Theory. The similarities in the curves of output versus input for different systems lead us to look for other similarities. For example, is there some analogy between the formulas for the entropy of signalling alphabets on telegraph lines to the entropy of some properties of social systems?

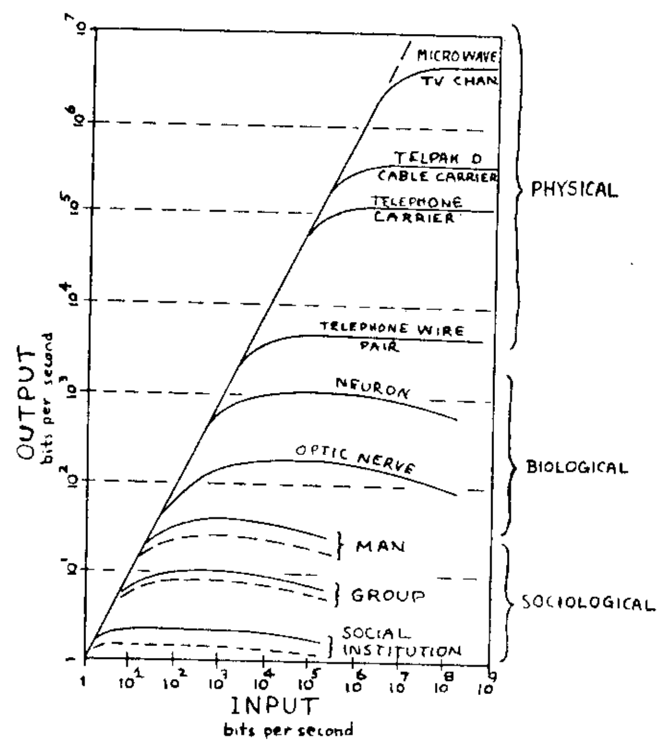


Fig. 1. Comparison of Information Input Overload Curves for Biological, Sociological and Physical Communication Channels

Figure 3 is omitted in this summary version.

BOUNDARY CONDITIONS FOR MAXIMUM NEGENTROPY

Fazlollah M. Reza summarizes the different boundary conditions for probability distributions that represent the principal different cases for maximizing entropy[7] in Fig. 2.

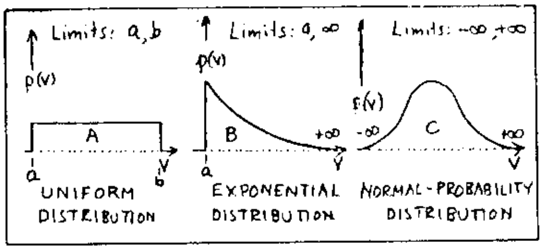


Fig. 2 Comparison of the Three Sets of Boundary Conditions for Maximizing Negentropy

What features of a sociological system might correspond to these three sets of boundary conditions? For the finite limits (a,b) it seems logical that the votes of people in a political system would have finite limits related to the finite number of people in a political state. Also, if we were to count the number of human freedoms people like to have, we would have a finite number of such freedoms to evaluate.

Next consider the boundary conditions (a,∞). The income distribution in a country might approximately meet these boundary conditions. Actually the boundary conditions for the income distribution at most would be (a,X), where X is a large number, but not really as large as infinity. For the boundary conditions (-∞,+∞), the scale of political philosophies is a candidate, except that they never reach infinity, but have the boundary conditions (-X,+Y), where -X represents the extreme left-wing political philosophy, or extreme communist views, and +Y represents the extreme right-wing conservative views or possibly anarchist views.

EXAMPLES FOR DIFFERENT BOUNDS

Case B: Finite Lower Bound and Infinite Upper Bound

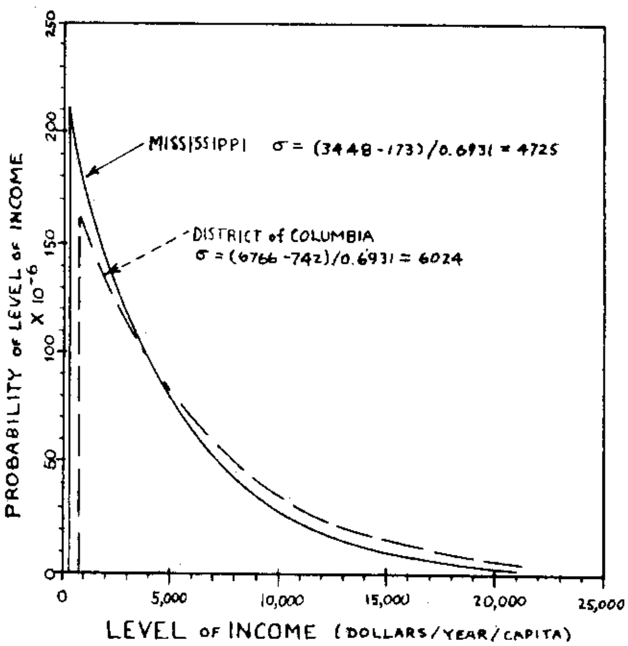


Fig. 5. Ideal Distribution of Income Levels for Two States Assuming 1973 Mean Income and 1973 Welfare Statistics

Case A: Finite Lower and Upper Bounds

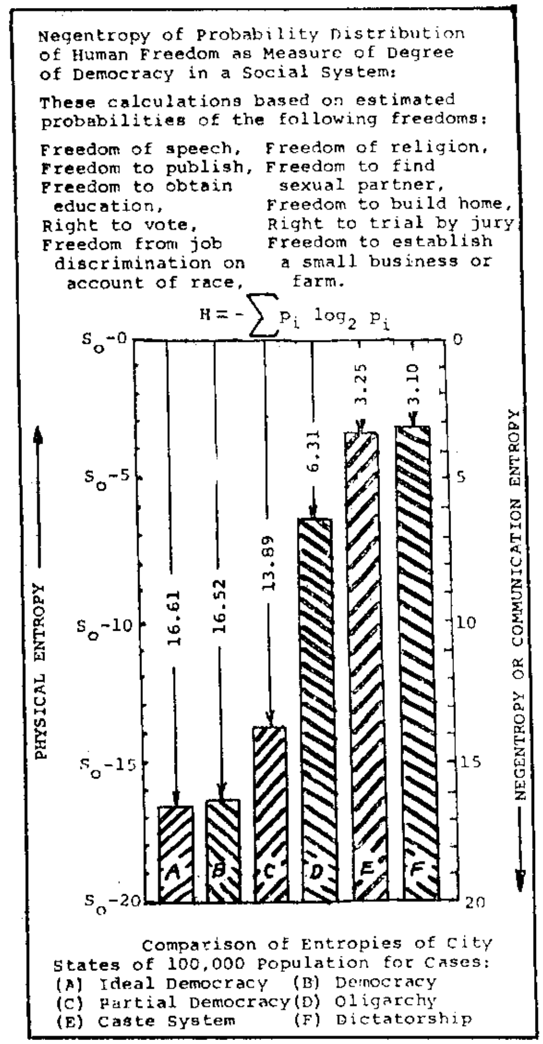


Fig. 4. List of Ten Human Freedoms and Resultant Values of Negentropy for Six Different Distributions of Human Freedoms

Case C: Upper and Lower Infinite Limits

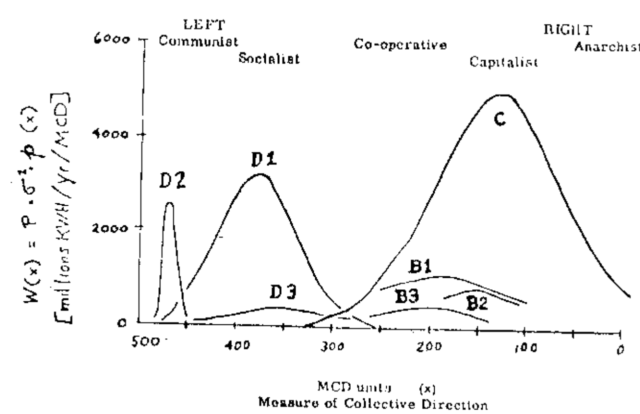
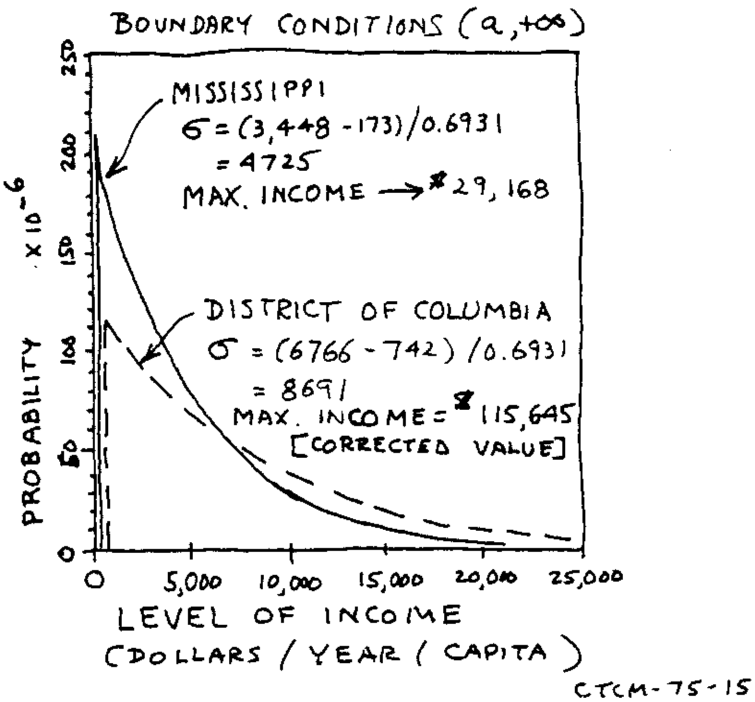


Fig. 6. Ideal Distribution of Power Versus Political Ideas for a Set of Countries

There is an error in the curves of Figure 5. A corrected set of curves is shown below to be substituted for the published Fig. 5.



Section 3.1.1: Completeness Theorems in Mathematics.

When mathematicians represent a physical or chemical property such as the temperature variation through a metal plate with different temperatures specified on the boundaries (boundary conditions), or the electromagnetic field in a waveguide they attempt to find mathematical functions which satisfy conditions of (1) orthogonality, and (2) completeness. For a discussion of orthogonality, see the chapter on "Eigenvalues and Eigenfunctions" in Margenau and Murphy.(1)

In our concern over the lack of a completeness theorem for biological and social systems, we need to understand what a completeness theorem is in the domain of mathematics where such theorems rigorously can be proved.

> A set of functions, $S_n(x)$, where n goes from 1 to ∞, is said to be complete if an arbitrary function, $f(x)$, satisfying the same boundary conditions as the functions of this set, can be expanded as follows:
>
> $$f(x) = \sum_{n=1}^{\infty} a_n S_n(x)$$
>
> where a_n are constant coefficients. (2)

An alternative reference to a "complete set of orthogonal functions" is the definition in The International Dictionary of Applied Mathematics.(3)

The simplest orthonormal set of functions is the Fourier Series:

$S_n = \sin nx, \qquad C_n = \cos nx,$ where

$$f(x) = \sum_{m=1}^{\infty} a_m \sin nx + \tfrac{1}{2} b_0 + \sum_{m=1}^{\infty} b_m \cos nx \qquad \text{for } -\pi \le x \le \pi$$

and the coefficients are defined as:

1. Margenau and Murphy, The Mathematics of Physics and Chemistry, NY: Van Nostrand(1943), pp. 240-267.
2. Ibid, p.243.
3. The International Dictionary of Applied Mathematics, Princeton, NJ: Van Nostrand(1960), p. 154, "Complete Set of Orthogonal Functions, Expansion In."

$$a_n = \int_{-\pi}^{\pi} f(y) \sin ny \, dy \; ; \qquad b_m = \int_{-\pi}^{\pi} f(y) \cos ny \, dy$$

Now we shall examine a simple example, using for f(x) the sawtooth waveform of Fig. 1.

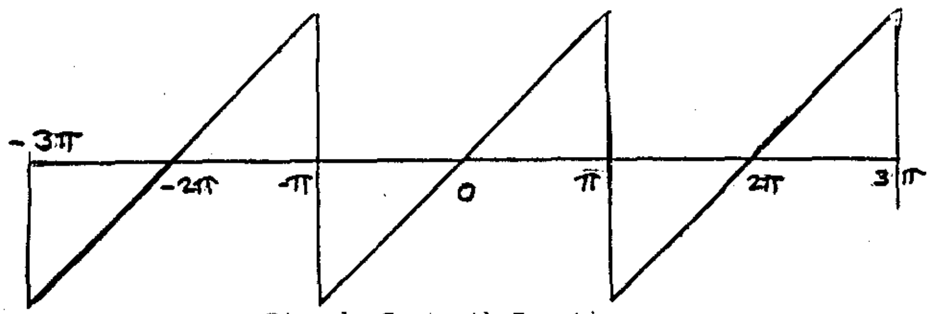


Fig. 1 Sawtooth Function

In Figures 2A, 2B, 2C, & 2D the effect of including one, two, three, and four terms of the Fourier series are shown. From the increasingly closer approximation of the series to the sawtooth function, exceot at the discontinuities at $\pm n\pi$, one can see that as n approaches infinity that the sum of the Fourier series approaches arbitraily close to the function f(x).

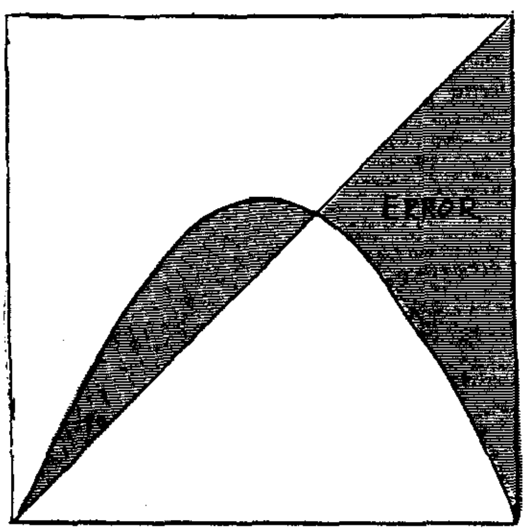


Fig. 2A- ONE TERM

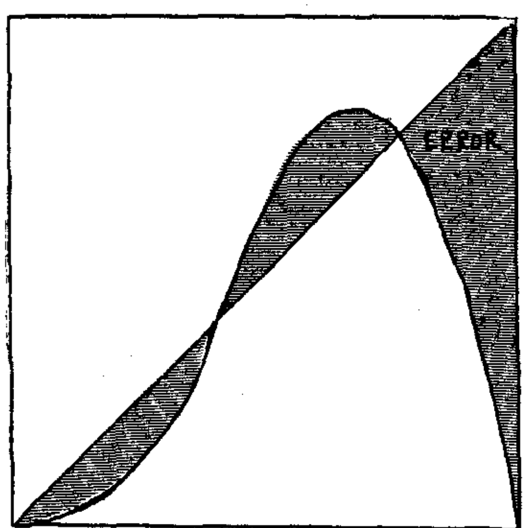


Fig 2B - TWO TERMS

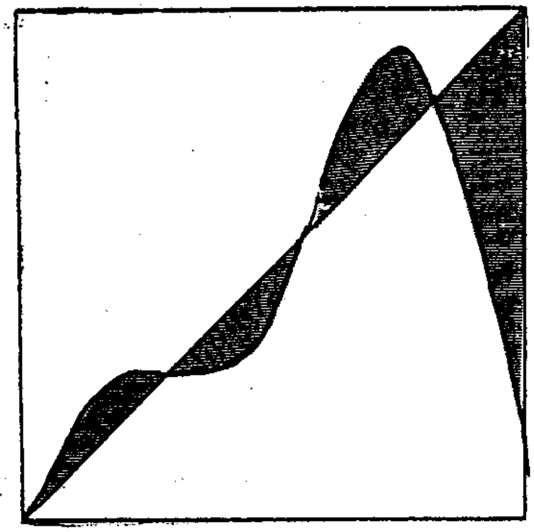


Fig 2C - THREE TERMS

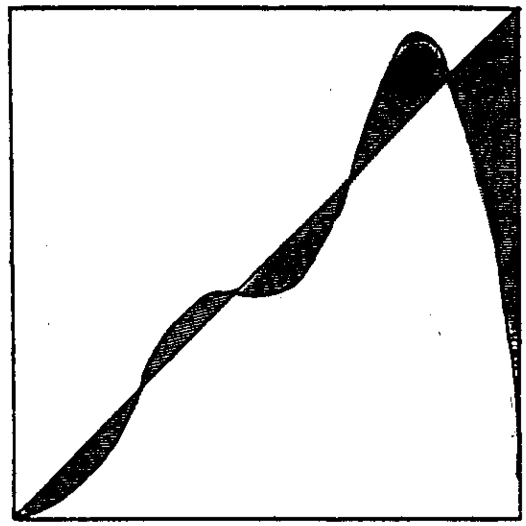


Fig 2D - FOUR TERMS

The above four illustrations show how successively adding one more term of the Fourier Series increases the accuracy.

For the above example: $a_n = 0$; $b_o = 0$; $b_n = (-1)^{n+1} \ (2/\pi n)$

It has been stated that it is not possible to prove a completeness theorem for the mathematical representation of biological or social system. (ZYGON, vol. 3, no. 3, Sept. 1968, p. 329)

As we move from "macro" or large scale phenomena to "micro" or quantum mechanics in atomic physics, we find that we no longer have a rigorous completeness theorem. Margenau and Murphy state that to the author's knowledge, a rigorous proof of the completeness of the eigenfunctions of all operators used in quantum mechanics has not been given, but is usually assumed.(4)

4. Margenau and Murphy, loc. cit., pp. 329-330.

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Section 3.9.8: Annual Index

Index to Volume I, Nos. 1-2 through 12
June-July 1970(Rev 8/70) to June 1971(Delayed 3/72)

In the process of reprinting some back issues of CTCM some sections have been renumbered. The table below indicates the correspondence between the original section numbers and the numbering used when reprinted.

Old Book Section (Page numbers)	New Book Section (Page numbers)
100(t-0)	397(1-2A)
100(t-0)	397(3-4)
99(1-4)	397(5-8)
98(1-2)	397(9-10)
99(5-10)	397(11-16)
98(3-4)	397(17-18)
99(11-12)	397(19-20)
97(t-2Z)	397(21-22)
99(13-14)	397(23-24)
97(t-2Y)	397(25-26)
97(t-2X)	397(27-28)
99(15-16)	397(29-30)

Section 3.9.9: List of Back Issues and Reprints (Continued)

This list is continued from File No. 399-F-19 (Book Section 399, Update F-19), pp. 3-4 in CTCM Vol. II, No. 5, pp. 31-32.

Vol. II, No. 5, July-Aug-Sept 1972(Publication delayed to 6/24/73, Reprinted 10/12/74). Outline of proposed book(omitted from reprint, see Vol. II, No. 6-A) Heating Systems and the Concept of Entropy. Semi-Public Bulletin Boards. Review of Books: Fraser, Some Reflections on Time, Science, and Man; LIFE Science Library, references to Cybernetics, Entropy, Feedback, Information Theory, Systems Analysis, and Systems Engineering; Cox, Capitalism as a System; Barnet, Roots of War. The Use of Cybernetics to Solve an Employee Communication Problem. Review of Book: Theil, Economics and Information Theory. Sample calculations of Entropy and Negentropy: (a) Entropy of Heating System, (b) Bulletin Board Space Allocation. Thermodynamics. Review of Books and Articles: Hiebert, DAEDALUS, "The Uses and Misuses of Thermodynamics in Religion." List of Back Issues. ... 32 pp. (Reprint 28 pp.) Reprint price $1.25

CTCM ISSUES

Delayed publication dates, revision dates, or reprint dates are in parentheses. COMMUNICATION THEORY in the CAUSE of MAN may be ordered on form on reverse side — as a magazine subscription, as individual back issues, or as the loose-leaf book version of magazine issues, separated into sections and assembled into the CTCM book.

VOLUME I

- No. 1-2, June-July 1970 (Rev. 8/70)
- No. 3-4 & 4-X, Aug-Oct 1970
- No. 5-6, Nov-Dec 1970 (Del. 3/71)
- No. 7-8, Jan-Feb 1971 (Del. 7/71)
- No. 9, Mar 1971 (Del. 8/71)
- No. 10-11, Apr-May 1971 (Del. 9/71)
- No. 12, June 1971 (Del. 3/72)

VOLUME II

- No. 1, July-Sept 1971 (Del. 6/72)
- No. 2, Oct-Dec 1971 (Del. 7/72)
- No. 3, Jan-Mar 1972 (Del. 1/73)
- No. 4, Apr-Jun 1972 (Del. 3/73)
- No. 5, July-Sept 1972 (Del. 6/73)
- No. 6-A, Oct-Dec 1972 (Del. 9/73)

VOLUME III

- No. 1, Jan-Mar 1973 (Del. 9/74)
- No. 2, Apr-June 1973 (Del. 7/75)
- No. 3, Jul-Sept 1973 (Scheduled Sept 1976)
- No. 4-A, Oct-Dec 1973 (Scheduled Oct 1976)

Magazine to Book conversion kits ($3.00 each) may be ordered as magazine issues. Kit consists of loose-leaf binder, index tabs, labels, and assembling instructions.

VOLUME II

- No. 6-B, Oct-Dec 1972 (Del. 9/73). For Vols. I & II.

VOLUME III

- No. 4-B, Oct-Dec 1973 (Scheduled Nov 1976). For Vols. I, II, & III.

Vol. II, No. 6-A, Oct-Nov-Dec 1972(Publication delayed to 9/16/73). Explanation of Frontispiece Figures. Additions and Corrections. Project Summary(Blue Page). Outline and Table of Contents for Loose-Leaf Book, COMMUNICATION THEORY in the CAUSE of MAN. Relationship of Application Communication Theory to the Larger Field of General Systems Theory. Equilibruim between Order and Diversity as a Factor in the Development of Democratic Institutions. Democracy through a Balance Between Order and Diversity. Examples of the Continuous Channel Model. .... 43 pp. Price $1.25

Vol. II, No. 6-B, Oct-Nov-Dec 1972(Publication delayed to 9/16/73). Kit for combining the separate issues of the Magazine CTCM from Volumes I & II into a loose-leaf book. Includes a binder and index tabs plus instructions for assembling. Price $3.00

Vol. III, No. 1, Jan-Feb-Mar 1973(Publication delayed to 9/28/74). Example of Relevance to Unitarian Social Concerns Committee. Special Preface on the Relevance of General Systems Models and Theories. List of other journals of interest. ... 20 pp. Price $1.25

Vol. III, No. 2, Apr-May-June 1973(Publication delayed to 7/13/75). "Blue Page" Project Summary. Telecommunications Technology for Congress. Politics on the Cable: A Cybernetic Approach to Access Allocation. On Lindsay's Thermodynamic Imperative. Review of Book: Berger, Rate Distortion Theory: A Mathematical Basis for Data Compression. Question 25: What is the usefulness of Lindsay's Thermodynamic Imperative? ... 34 pp. Price $1.25

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Section 1.0.2: The Thermodynamic Imperative - A Star to Steer By in a Disconnected Society.

See Section 1.0.2A for extension to "Negentropic Imperative."

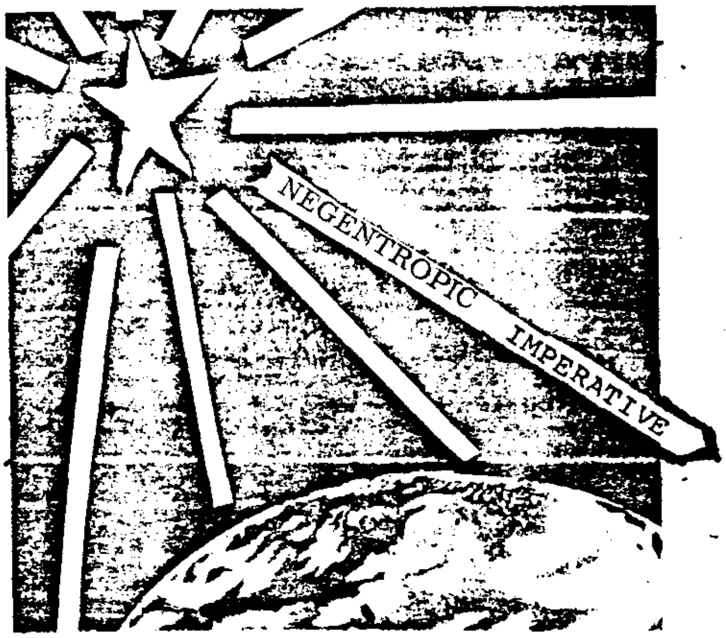


Fig. 102-1

The Long Range Planning Committee of the San Jose Unitarian Church has considered a number of developments in the Unitarian-Universalist denomination that may influence our future. One development reported in the magazine, ZYGON, published by Meadville-Lombard Theological School in Chicago points to a star to steer by through the complex problems of future -- the "thermodynamic imperative". Professor Lindsay in an article, "The Larger Cybernetics," June 1971, pp. 126-134, says: "...we as individuals should endeavor to consume as much entropy as possible to increase the order in our environment. This is the thermodynamic imperative, possibly not unworthy to rank alongside the categorical imperative of Kant or even the Golden Rule."

The diagram on the right indicates how this principle of the "thermodynamic imperative" can be used to help connect decision processes with ethical values in our disconnected society. An example is given on the next page of how the equations for the analysis of the distribution of messages on a telegraph cable can be used to simulate the functions of a political system in an approximate way that permits calculating the 'communication entropy' so one can apply the "thermodynamic imperative to the social system.

To understand this principle, we need some definitions.

"thermodynamics" is a branch of physics relating to the conversion of heat energy into mechanical energy and vice versa.

"entropy" is a measure of the grade of energy. The lower the entropy, the more accessible the energy is for conversion into useful work.

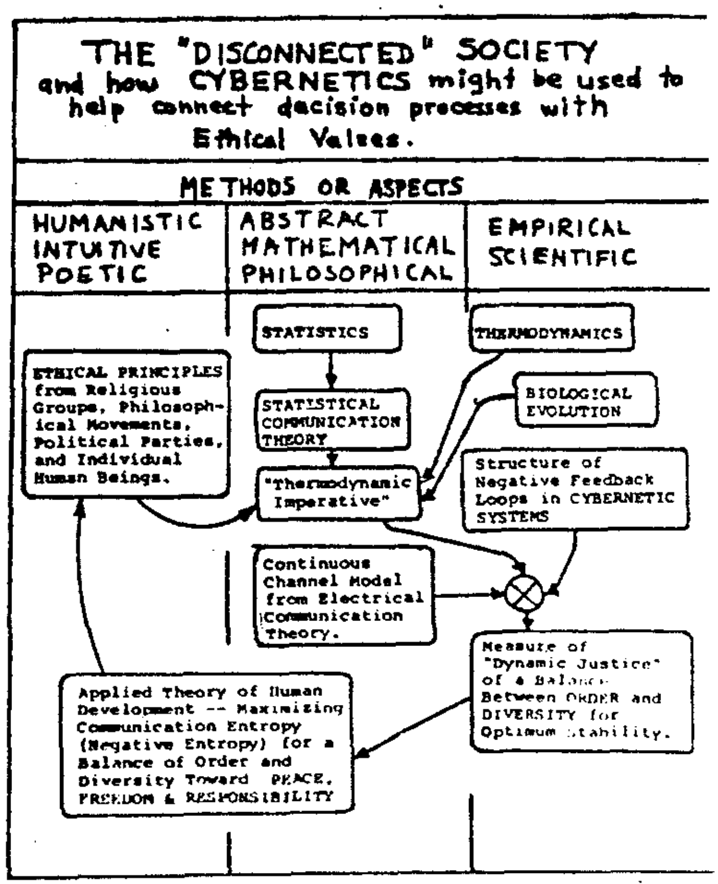


Fig. 102-2

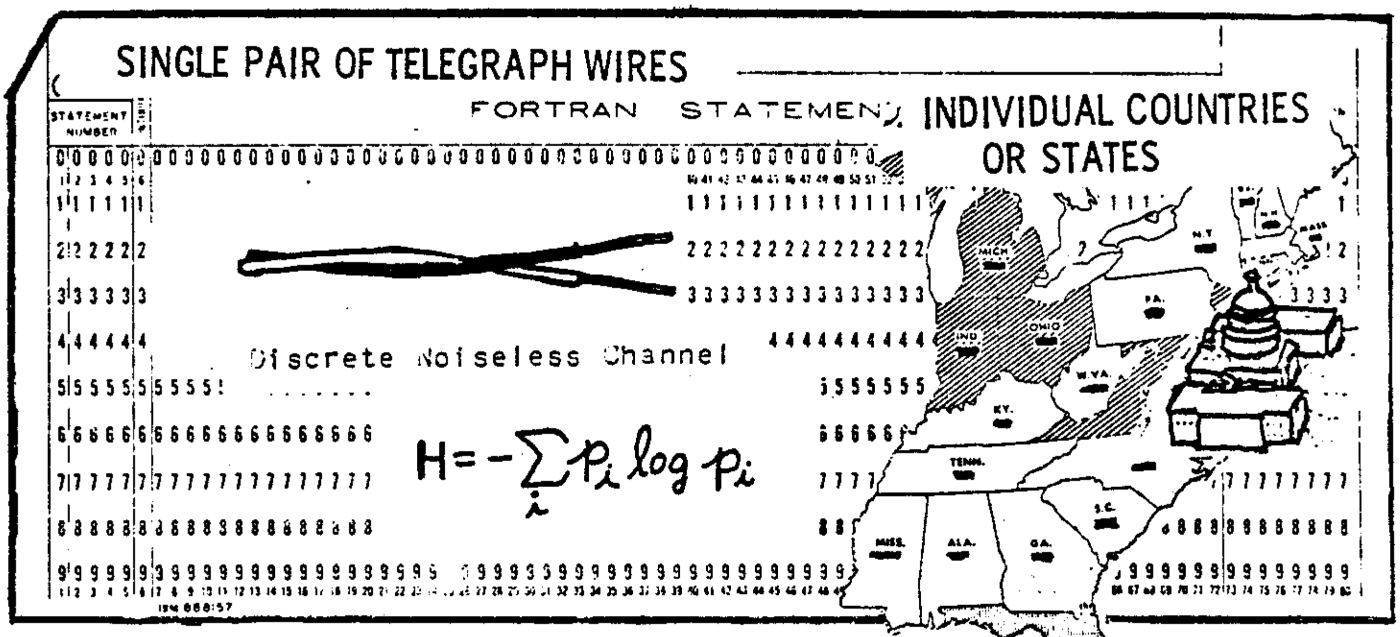
The phrase "consume... entropy" can be interpreted to mean to decrease entropy, or increase "negative entropy," which is sometimes called "negentropy." Professor Fano uses the term "communication entropy" for the negative entropy defined in terms of the probabilities of messages being sent over a telegraph line.

The term "to increase the order in our environment" is confusing to a number of people. Perhaps Lindsay should have said "to increase the communication entropy in our environment." More sophisticated models than the telegraph line model used in this paper correlate increasing the communication entropy with optimizing the balance between order and diversity.

Example of Implimentation of "Thermodynamic Imperative" using an ideal telegraph line:

When a set of human freedoms relating to speech, religion, publication, sex, education, absence of job discrimination, home ownership, voting, trial by jury, and right to establish a small business or farm is treated like a set of telegraph messages such that the corresponding probabilities are substituted into the formula for negative entropy, the relative measure of democracy for six different hypothetical countries come out as follows:

Country A, Ideal Democracy	16.61	Country D, Oligarchy	6.31
Country B, Democracy	16.52	Country E, Caste System	3.25
Country C, Partial Democracy	13.89	Country F, Dictatorship	2.98



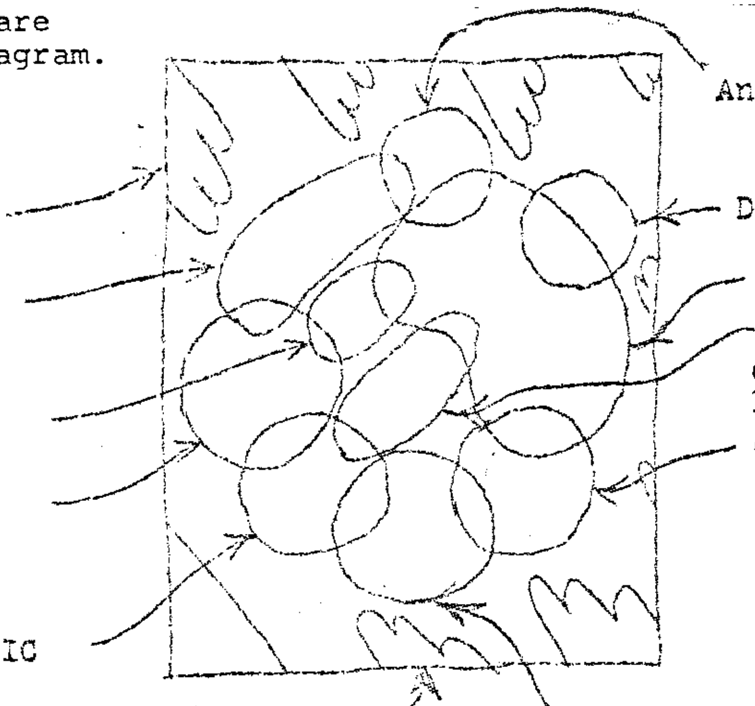
Use of the equations for communication entropy of telegraph messages to measure the degree of "democracy" in a country by calculating the negative entropy of a set of human freedoms.

Fig. 102-3

Explanation of Frontispiece Figures:

(See Loose-leaf Book or CTCM Vol. II, No. 6-B)

The elements of the color painting at the top section of the frontispiece are explained in this diagram.



(The stalactites and the stalagmites represent the problems closing in on mankind.)

A Man and Computer Struggling to Cope with the Problems of an Increasingly Complex Society

The second figure in the frontispiece is symbolic of how Lindsay's "Thermodynamic Imperative" can be generalized to the principle of the "Negentropic Imperative" through the extension to entropy-like properties of systems on different levels, to provide a star to steer by in our disconnected society. However the "thermodynamic imperative" cannot be tested without the development of a systems model which makes contact with real sociological systems. The aim of this magazine is to provide an approximate model for this use until general systems theorists agree upon a more general and specific model.