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COMMUNICATION THEORY in the CAUSE of MAN

VOL. I NO. 12

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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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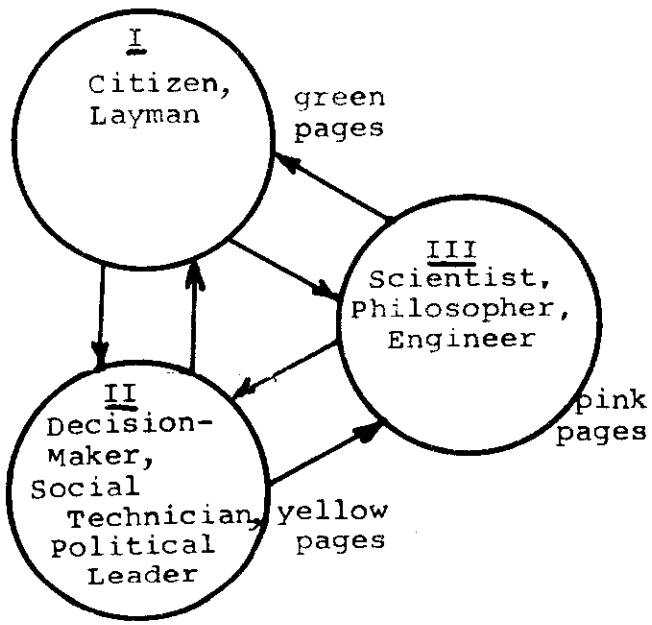
This issue of COMMUNICATION THEORY in the CAUSE of MAN has been delayed a number of months, while the editor was trying a number of alternatives for presenting material on three levels of complexity together in the same issue. The problem stems from the question of who is going to benefit from research 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:



This issue of CTCM represents a partial conversion to the new organization. It will probably take two or three issues to fully implement this concept of separating the three types of material into the green, yellow and pink sections.

CONTENTS OF THIS ISSUE

Section 3.9.9 is omitted in the August 1973 Reprint of Vol. I, No. 12, since a later version appears in Vol. II, No. 2.

NUMBERING SYSTEM FOR FILES(and Sections):

Series 000: Title page, editorial notes(white pages)

Series 100: General Descriptive Articles(green pages)

Series 200: Applications to Specific Problems(yellow pages)

Series 300: Technical Details and Testing of Hypotheses (pink pages)

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.
'13' in File No. 97-F-13 indicates updating to September 5, 1971.
'14' in File No. 97-F-14 indicates updating to March 5, 1972

This issue of CTCM has been long delayed. In June 1971, I planned a paper for the Second Annual Institute of Systems Education of the National Task Force on Systems Education (Western Division) of the Society for General Systems Research to be held at San Jose State College, September 9-10, 1971. I completed the paper July 25th, in time to mail copies to participants of the Institute.

The Institute in September was very valuable to me, in that the discussion of my paper helped me get at some questions I had never been able to resolve before. I had intended to copy the discussion of my paper on "Entropy-Like Properties of Different Levels of Systems" from the Conference Proceedings in this issue of CTCM. Since the proceedings haven't come out yet, I am summarizing some of the more important criticisms of my paper in Section 2.2.8 of this issue of CTCM. Since I may have only remembered the criticsms that were useful to me, I will gladly print more detailed criticisms when available.

I appreciate particularly the comments and criticism from Mr. Scott Mercer and Dr. Perri J. Stinson. I also found Dr. George G. Lamb's paper very significant to me: "Systems Education: OAELIS: An Open Adaptive Evolutionary Learning Innovative Systems Approach." In additio I had the opportunity to have further discussions with Dr. Lamb during the institute. From discussions with Dr. Lamb I came to the realization that electrical engineers and chemical engineers look at the entropy of a system slightly differently. To compare how electrical and chemical engineers apply the concept of entropy to social systems in slightly different ways may lead to a more creative synthesis.

In the later part of September I went back-packing in the Desolatio Valley Wilderness Area in the Sierras with our younger son, Pete, who is a student at Cal Berkeley. Under the stimulus of the natural surroundings of the wilderness, I got to meditating about many of the ideas discussed at the systems education institute.

In the following months, I prepared drafts of three issues of CTCM. I couldn't decide which issue to publish first. Whichever one I would tentatively select for the next issue seemed to require some material from one of the other two for easy understanding. I finally decided that the most important thing for the next issue would be to make some progress report on all questions that have come to my attention, whether by formal letter to the editor, oral discussion, or brief comment. It is my aim to respond to any and all questions which are directed to me in connection with the material published in CTCM.

To systematically respond to all questions, I have summarized all previous questions discussed in CTCM in the first six questions discussed in Section 3.9.6 of this issue. Then I have listed all known questions that have come to my attention since the earlier issues of CTCM. I have at least made a preliminary response to each question even if I am not yet prepared to make a definitive answer to every question.

This issue completes Volume I of CTCM. The two other issues which are almost ready to publish will be called Vol. II, No. 1, July-Sept 1971 and Vol. II, No. 2, Oct-Dec 1971. I plan to issue six issues in Volume II with each issue covering a three month period. This will

make Volume II end in December 1972, so that future volumes can start at the beginning of the calendar year. My apologies to all the librarians who may be confused by the irregular dates and changing numbering of CTCM.

I have had some people object to the mathematics in some issues of CTCM. Some say they can't understand mathematics. Others say that mathematics can't possibly have any relevance to human problems of social systems. To deal with the range of different objections to mathematics, I am experimenting with the use of different colors of paper for different types of articles as is described on the front cover of this issue. People who don't have the mathematical background can read the green pages and some of the yellow pages. Mathematical details, scientific proofs, and philosophical questions will be relegated to the pink pages at the back of each issue of CTCM.

A section (1.1.5) on "What has cybernetics got to do with the quality and survival of human civilization?" is included in this issue of CTCM. Following each of the fourteen statements is a list of references in CTCM or other sources where further material can be found relative to the statement. Where there is no known published material available, at least the conference at which the concepts have been discussed is noted.

New Publications Not Listed Elsewhere:

T. C. Helvey, The Age of Information - An Interdisciplinary Survey of Cybernetics. Englewood Cliffs, N.J.: Educational Technology Publications(1971) 205 pp. $8.95

Gerd D. Wallenstein, "The Humanization of Technical Man," Cybernetic Systems Monograph, No. 1, January 1972, 23pp. San Jose State College, San Jose, Calif. 95114. $1.00(by mail $1.50)

Leo P. Kadanoff, "From Simulation Model to Public Policy," American Scientist(New Haven, Conn.), Vol. 60, No. 1, Jan-Feb 1972, pp. 74-79. A case study of the relationship between simulation models of urban social systems and evaluations of proposed public policies.

Cybernetics including the related fields of Information Theory and Computer Simulation can provide us with a number of tools which can be used to help guide our civilization in the following areas:

(1) Form of social evolution.- Through cybernetics we can apply some incomplete research from general systems theory that shows a similar form in physical, chemical, biological, psychological, and sociological evolution. With an understanding of the potential isomorphic forms in these different fields we can develop better hypotheses as to the probable practical directions of social evolution.

> For an introduction to material on social evolution see:
> CTCM Vol. I, No. 1-2, Section 1.1.2: Civil Rights and Evolution, pp. 11-13, June-July 1970.
> CTCM Vol. I, No. 1-2, Section 1.0.0: Preface, p. 8B, June-July 1970.
> CTCM Vol. I, No. 3-4, Section 2.3.2C: An Example of the Modified Thermodynamic Imperative, pp. 19-22, Aug-Sept 1970.
> CTCM Vol. I, No. 5-6, Section 0.9.9: Letter to the Editor and Reply, pp. 4-6, Nov-Dec 1970.
> CTCM Vol. I, No. 7-8, Section 1.1.2: ...rise and fall of 20 civilizations..., pp. 5-6, Jan-Feb 1971.
> CTCM Vol. I, No. 7-8, Section 2.5.3: Questions: ... social evolution and sociological uncertainty principle..., p. 16, Jan-Feb 1971.
> CTCM Vol. I, No. 9, Section 1.5.0: Complex problems .... bio-social evolution, p. 6, March 1971.
> CTCM Vol. I, No. 10-11, Section 1.6.4: ....the future of society ... growth curves of values over 2000 years, p. 24, Apr-May 1971.

(2) Measure of democracy.- Through a discrete channel model from Information Theory, we can measure the degree of democracy in a state or nation by statistical use of the probabilities of people having different freedoms. Cybernetics and Information Theory focus attention to the needs and roles of minorities in the functioning of the nation.

> CTCM Vol. I, No. 5-6, Section 1.1.1: ...negentropy as measure of democracy, pp. 11-12, Nov-Dec 1970.

(3) Understanding of potential for social change.- Computation of entropy of a social system can give a measure of the potential for social change, similar to the way in which the entropy in a chemical thermodynamic system gives a measure of the useful work that can be obtained from the system.

> George G. Lamb, "Basic Concepts in Subjective Information Theory, Thermodynamics, and Cybernetics of Open Adaptive Societal Systems," IEEE Record of Systems and Cybernetics Symposium, Philadelphia, October 1969.

(4) Measure of stability.- Through a continuous channel model from Information Theory, we can determine the optimum probability distribution of philosophical ideas in a society to maximize human freedom consistent with having sufficient stability to protect that human freedom.

CTCM Vol. I, No. 3-4, Section 2.3.2C: Modified Thermodynamic Imperative...optimum distributions of power among people of different philosophies for stability of social system.., pp. 19-22, Aug-Sept 1970.

(5) Understanding inter-industry relations.- Through the use of the Leontiev matrices of input-output economic analysis, cybernetic analysis can give us a deeper understanding of our industrial structure and aid us in planning economic changes. This can also aid us in planning the transformation from war-oriented economy to a peace-oriented economy.

Wassily W. Leontief, "Input-Output Economics," Scientific American, Vol. 185, No. 4, Oct 1951, pp. 15-21.
Wassily W. Leontief and Marvin Hoffenberg, "The Economic Effects of Disarmament," Scientific American, April 1961.

(6) Feedback loop structure in political and economic systems.- Analogies from negative feedback circuits in electro-mechanical systems studied in electrical engineering can help us understand the structure of feedback loops in political and economic systems.

Karl W. Deutsch, The Nerves of Government, Models of Political Communication and Control, The Free Press of Glencoe(1963)
David Easton, A Systems Analysis of Political Life,John Wiley (1965)

(7) Simulation of business and political systems.- Simulation techniques have been developed in cybernetics that make it possible to simulate the major functions of an organization such as a corporation or a government agency in order to evaluate alternative policies. At present such simulation tools tend to be more available to large business corporations and military departments of the government. Knowledge of the multidisciplinary and inter-disciplinary features of cybernetics can help make these simulation techniques more accessible to the individual citizen, engineer, scientist, religious leader, and concerned political groups.

Simulation in the Service of Society,monthly newsletter, Volume 1, 1971, Box 994, La Jolla, California 93037.

(8) Management systems.- The most general application of techniques of cybernetics so far is in business management systems. It is important for the layman to understand the general nature of business management techniques which makes it possible for large corporations to operate efficiently. There is serious danger to the survival of our civilization where the factors which are difficult to reduce to dollar values are thrown out of the decision formulae by business and military leaders. Cybernetics can help make an accounting of how unreliable management systems are,due to their disregarding of the principle of "completeness."

Stafford Beer, Cybernetics and Management, Wiley Sci Ed.
Stafford Beer, "Managing Modern Complexity," The Management of Information and Knowledge,(Washington D.C., Government Printing Office, 1970), pp. 41-62.

(9) Problems of population explosion.- Cybernetics can aid the citizen understand the impact of uncontrolled population explosion on our planet.

> Richard M. Korf, "An end to all this," Playboy, 18, 7 (July 1971). A summary of the work of Jay W. Forrester and the MIT branch of the Club of Rome concerning the quality of life and the predicament of mankind.
> Jay W. Forrester, "Counterintuitive behavior of social systems," Technology Review (MIT) 73 3 (Jan 1971) 53-68 and Simulation (La Jolla, Calif.) 16 2 (Feb 1971) 61-76.

(10) Ecological unbalance.- Cybernetics can aid us keep track of unbalances in the ecology. In a way similar tc the methods used by Soviets to add an extra wing to the Leontiev matrix to include capital requirements and capital velocity, we can add wings to the matrix on air pollution, water pollution, carbon dioxide unbalance, depletion of natural resources, garbage production, and polar ice-cap stability. (The references below developed some important basic techniques, but do not go as far as adding ecological wings to the input-output table.)

> Jay W. Forrester, World dynamics, Wright-Allen Press, Cambridge, Mass. 1971 142pp., $9.75. A world model involving population, natural resources, capital investment, capital-investment-in-agriculture fraction, and pollution.
> Ronald E. Morgan and Roger Weinberg, "Computer simulation of world systems: Biogeochemical cycles," Kansas State Univ. Dept. of Computer Science, Manhattan, Kansas, March 1971. (Reviewed in Simulation in the Service of Society, Vol. 1, No.5, May 1971, p. 3)

(11) Communication era input-output tables.- The Leontiev matrices of input-output economic analyses are essentially two-dimensional power era matrices. The techniques of cybernetics suggest a three-dimensional input-output matrix expanding the Leontiev matrix to include force era residual elements on one level, power era residual elements on a second level, and communication era elements on the third level.

> This was discussed informally at the Conference on Cybernetics and Society, Georgetown University, November 19, 1964, but was not included in the published proceedings.

(12) Political ideology.- The concepts of image compression from information theory suggest an interpretation of the nature of political ideology. From this trend in research, we should be able to develop a suitable political ideology for more positive political action, yet be balanced with suitable checks and balances.

> These possibilities were discussed in Berkeley at the Unitarian Laymen's League meeting of October 8, 1965, but have not been developed in any formal publication.

(13) Technological meditation.- Cybernetics offers us a new tool, which I call "technological meditation." In the past one could meditate more easily on a mountain peak, in the remote wilderness, or in a church, temple, or synagogue. With a deep knowledge and experience in using cybernetics, one can meditate on social problems in an artificial environment such as a computer laboratory, department store, or urban slum. To avoid false application of the process of "technological meditation" something like Esalen-derived encounter groups are necessary to test the products of technological meditation.

> CTCM Vol. I, No. 1-2, Section 2.1.5: Technological Meditation, pp. 19-21, June-July 1970.

(14) Testing of hypotheses.- The more general use of the viewpoint of cybernetics can increase the amount of feedback in a social system to provide for testing of hypotheses similar to the way physical scientists test their hypotheses.

> CTCM Vol. I, No. 1-2, Section 3.3.0: Status of Entropy....., pp. 27-28, June-July 1970.
> CTCM Vol. I, No. 3-4, Section 2.1.4: Science and Hypothesis, pp. 13-16, Aug-Sept 1970.
> CTCM Vol. I, No. 5-6, Section 2.5.1C: Chart for Testing Hypotheses....., p. 21, Nov-Dec 1970.

I plan to elaborate on all the above statements in due course of time in future issues of COMMUNICATION THEORY in the CAUSE of MAN.

Frederick B. Wood

This page is an abatract of a paper presented at the

SECOND ANNUAL INSTITUTE OF SYSTEMS EDUCATION
of the
NATIONAL TASK FORCE ON SYSTEMS EDUCATION (WESTERN DIVISION)
of the
SOCIETY FOR GENERAL SYSTEMS RESEARCH
at
San Jose State College, San Jose, California, September 9-10, 1971

Abstract

This paper consists of four sections of a proposed book on "Communication Theory in the Cause of Man." Chapters and discussions are being first issued as bimonthly issues of a magazine, CTCM.

Section 0.9.9: Objectives: Two hypotheses are stated, namely that (1) for our civilization to survive, we must understand the nature of the possible critical paths of social evolution, and (2) the problem is compounded in that a collapsing country could release enough atomic radiation to destroy life on our planet. Then two hypotheses on potential solutions are given, namely (3) the fundamental and thorough approach is to develop homeostatic cybernetic feedback loop simulations of the world political systems, and (4) there is a complementary method that may give us rough estimates more quickly, namely the defining and analyzing entropy-like properties of social systems.

Section 1.1.1: Introduction: Some of the problem crises in sociology, elementary feedback loops in cybernetics, information theory and the potential link between measurable and non-measurable entities by use of concept of entropy, and a sample calculation pointing to the analysis of political and religious liberty through maximizing negentropy (or communication entropy).

Section 2.3.2: Ethics, Thermodynamic Imperative, and an Implementing Electrical Communication Theory Model: Consideration of Immanuel Kant's "categorical imperative," Albert Schweitzer's "Reverence for Life," and a "Thermodynamic Imperative" based on fighting the Second Law of Thermodynamics. Examples of the confusion inherent in trying to translate "entropy" into simple terms like "order and disorder." A modified thermodynamic imperative requiring a skeleton model for interpretation.

Section 3.3.0: Status of Entropy and Related Concepts: First a strict equivalence between information and entropy exists only at the quantum level. As one goes to more complex levels of nature, it is postulated that calculations of entropy are only significant when the other properties of the system remain constant or are known reliably. A table of sixteen levels of systems is presented with preliminary labeling of the categories of properties that must be either known or constant for each level of complexity in order for the entropy-like properties of the system at that level to be significant.

Appendix: Outline of Projected Book: COMMUNICATION THEORY in the CAUSE of MAN. This outline is included to help the reader see how these sections fit together.

Feedback: In addition to the discussion planned for the Second Annual Institute of Systems Education at San Jose State College, space is being reserved in the next few issues of CTCM for letters to the editor from those whose disagree or wish to comment on the views of this paper.

All sections of this paper have been published in separate issues of COMMUNICATION THEORY in the CAUSE of MAN. A complete set of the sections of this paper is available as Socio-Engineering Problems Report No. 401, 21pp., price $1.00.

Summary of Discussion of This Paper at Institute of Systems Education, San Jose State College:

Dr. Perri J. Stinson, Professor of Operations Research and Statistics, California State College at Long Beach, reviewed the historical development of information theory to establish a perspective for evaluating this paper. Dr. Stinson pointed out that this paper deals only with probabilistic information theory, and that there is a related non-probabilistic information theory being developed. Two references on non-probabilistic information theory from the proceedings of the Academy of Science in Paris are:

> B. Schweizer and A. Sklar, Comptes rendus, t. 269, series A, 1969, p. 721-.
>
> Joseph Kampé de Fériet, THÉORIE DE L'INFORMATION.- Mesures de l'information par un ensemble d'observateurs. Comptes rendus, t. 269, series A, 1969, p. 1081-5.

I have not yet assimilated the above material, but I have prepared an elementary approach to relating probabilistic and non-probabilistic information in connection with the discussion of "Question 7" in Section 3.9.6.

Dr. Stinson suggested that "entropy" should be defined at the beginning of the paper. G. N. Lewis' definition "gain in entropy always means loss of information and nothing more" would help people understand.

Dr. Stinson questioned the generality of the "natural tendency ...for order in the universe to be transformed into disorder" in the statement of the "thermodynamic imperative" on page 11 of SEPR 401. Generally values relate to a particular sub-cultures and thus lack generality. In social systems there are forces running the establishment organization which are trying to minimize information and there are insurgents in the system trying to increase information. See E. Feit, University of Massachusetts, Amherst, "Insurgency In Organizations: A Theoretical Analysis," General Systems, Vol. XIV, 1969, pp. 157-168.

Mr. Scott Mercer, Cybernetic Systems Student, San State College, reviewed the paper, and commented that:

(1) it is difficult to follow parts of the logical development, because definitions of the terms used are not included in the paper, and
(2) there is an error of sign in the formula for negentropy at the bottom of page 7 of SEPR No. 401(CTCM I/5-6 p.11 or File No. 111-F-10 p. 5).

I plan to start a glossary in a future issue of CTCM to make definitions of the concepts I am using more accessible to the reader. I am planning to make graphical plots of any entropy or negentropy calculations in future issues of CTCM to reduce the chance of any confusing typographical errors.

Table I gives the numerical values of uncertainty and negentropy components as a function of probability. These values can be used in calculating the negentropy of membership statistics for use in allocating bulletin board space as in done in the examples given in Sections 1.2.4 CTCM I/3-4. For values not in this table the curves of Fig. 1 can be used to estimate the values.

TABLE I: NEGENTROPY COMPONENTS

i	Probability p_i	Uncertainty $-U_i = \log_2 p_i$	Negentropy Component $U_i p_i$
1	0.9999930	-0.0000101	0.0000101
2	0.9999900	-0.0000144	0.0000144
3	0.9999700	-0.0000433	0.0000433
4	0.9999500	-0.0000721	0.0000721
5	0.9999300	-0.0001010	0.0001010
6	0.9999000	-0.0001443	0.0001443
7	0.9997000	-0.0004329	0.0004328
8	0.9995000	-0.0007215	0.0007212
9	0.9993000	-0.0010103	0.0010095
10	0.9990000	-0.0014434	0.0014420
11	0.9970000	-0.0043346	0.0043216
12	0.9950000	-0.0072316	0.0071954
13	0.9930000	-0.0101344	0.0100634
14	0.9900000	-0.0144996	0.0143546
15	0.9700000	-0.0439434	0.0426251
16	0.9500000	-0.0740006	0.0703006
17	0.9300000	-0.1046974	0.0973686
18	0.9000000	-0.1520032	0.1368028
19	0.7000000	-0.5145733	0.3602013
20	0.5000000	-1.0000003	0.5000001
21	0.3000000	-1.7369660	0.5210898
22	0.1000000	-3.3219289	0.3321929
23	0.0700000	-3.8365022	0.2685551
24	0.0500000	-4.3219292	0.2160965
25	0.0300000	-5.0588949	0.1517668
26	0.0100000	-6.6438578	0.0664386
27	0.0070000	-7.1584312	0.0501090
28	0.0050000	-7.6438580	0.0382193
29	0.0030000	-8.3808239	0.0251425
30	0.0010000	-9.9657867	0.0099658
31	0.0007000	-10.4803600	0.0073363
32	0.0005000	-10.9657869	0.0054829
33	0.0003000	-11.7027527	0.0035108
34	0.0001000	-13.2877157	0.0013288
35	0.0000700	-13.8022889	0.0009662
36	0.0000500	-14.2877158	0.0007144
37	0.0000300	-15.0246818	0.0004507
38	0.0000100	-16.6096444	0.0001661
39	0.0000070	-17.1242177	0.0001199

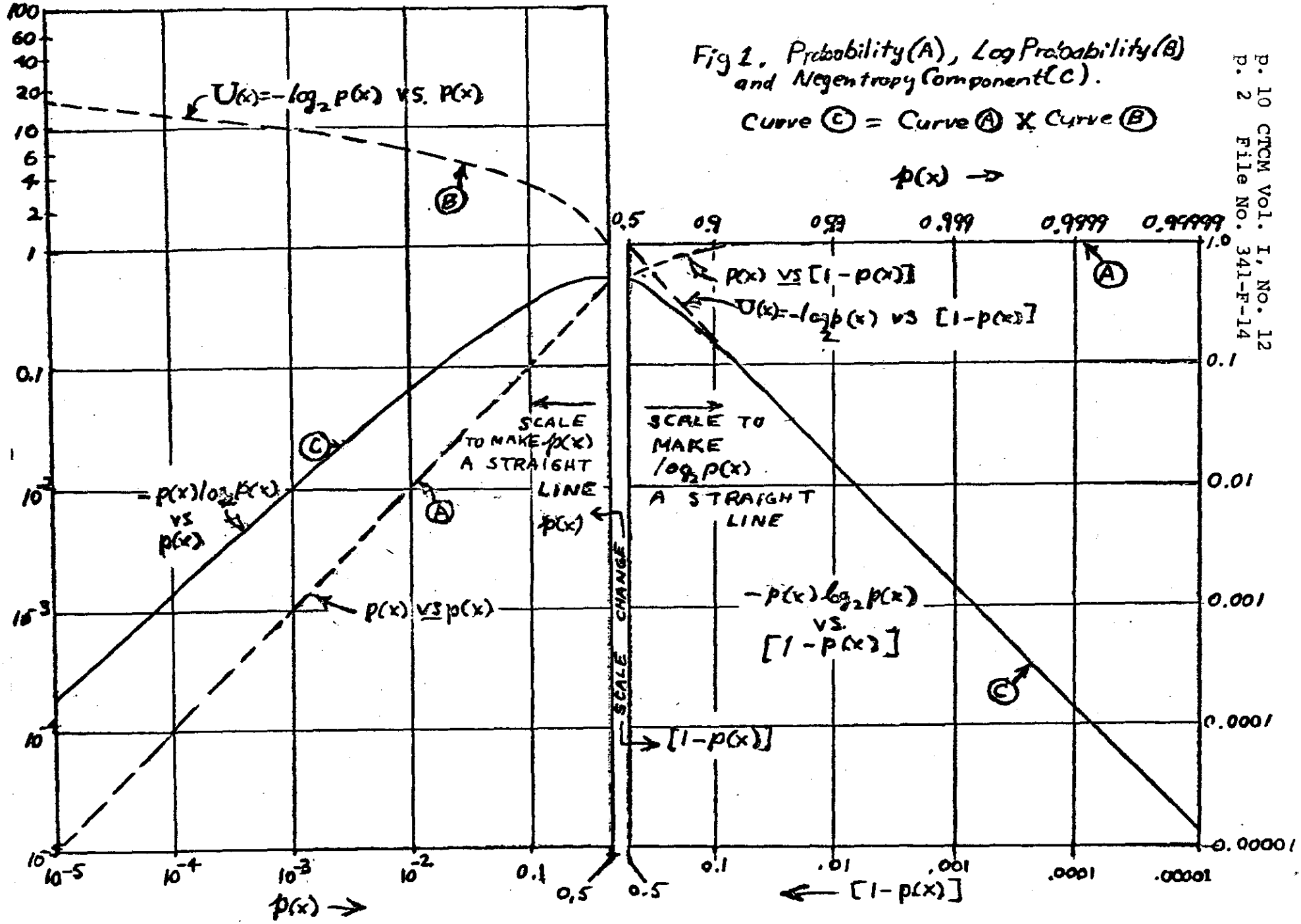


Fig 1. Probability (A), Log Probability (B) and Negentropy Component (C).
Curve (C) = Curve (A) X Curve (B)
$U(x) = -\log_2 p(x)$ vs. $p(x)$
$p(x) \rightarrow$
$p(x)$ vs $[1-p(x)]$
$U(x) = -\log_2 p(x)$ vs $[1-p(x)]$
SCALE TO MAKE $p(x)$ A STRAIGHT LINE
SCALE TO MAKE $\log_2 p(x)$ A STRAIGHT LINE
$-p(x)\log_2 p(x)$ vs. $p(x)$
$p(x)$ vs $p(x)$
$-p(x)\log_2 p(x)$ vs. $[1-p(x)]$
SCALE CHANGE
$[1-p(x)]$
$[1-p(x)] \rightarrow$
100
60
40
20
10
6
4
2
1
0.1
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0.5
0.9
0.99
0.999
0.9999
0.99999
1.0
0.01
0.001
0.0001
0.00001
.1
.01
.001
.0001
.00001
A
B
C

The questions which have heretofore been stated either in the editorial notes at the beginning of each issue of CTCM or in Section 2.5.3 on testing of hypotheses are now listed in this section.

Question 1: Two objections are raised to the "Thermodynamic Imperative."

(a) Three people object that the thermodynamic imperative leads to the conclusion that the best possible world is a 100% mosaic structure, which is not tolerable to them.

See CTCM I/3-4, 17; and p. 18; and p. 19 for details.

My general response is to go into more detail and show how the "Modified Thermodynamic Imperative" deals with a balance between order and diversity when one uses an appropriate model from electrical communication theory.

See CTCM I/3-4 pp. 19-22 for details(File 232 pp. 5-8) Summarized in CTCM I/7-8 p. 15(File 253 p. 1)

(b) One reader states that the fallacy in Lindsay's argument is that life creates negentropy at the expense of its environment. Smog, contamination, pollution, and mountains of garbage are the by-products of the negentropy that our society is producing.

See CTCM I/3-4, p. 17(Section 2.3.2B, File 232 p. 3)

My response to this criticism is that measurement of the negentropy of a bio-social system is only looking at a very important single one of a group of sixteen parameters that are important in the understanding of large bio-social systems. If the other fifteen parameters are held constant, then two bio-social systems can be compared simply by comparing their negentropies.

For a tabulation of these sixteen groups of parameters, see CTCM I/1-2 pp. 27-28(File 330 pp. 1-2).

Question 2: One reader suggests that an example of the calculation of entropy change in the cycle of a steam engine be included in a future issue of CTCM to give the reader a better starting point for the application of the concept of entropy to other fields.

See CTCM I/7-8 p. 15(File 253 p. 1) for details.

I have looked up the 1935 edition of Hirshfeld and Barnard, Heat-Power Engineering: Part I Thermodynamics and Prime Movers, N.Y.: John Wiley, which was the text when I took a mechanical engineering course on thermodynamics many years ago. I haven't decided which engine cycle to use for the illustration. Also I am considering using an example in Meter-Kilogram-Second units instead of the old British units.

Question 3: A reader objects to the maximization of ORDER, and asks can't we maximize something which for want of a better term might be called "Harmony."?

See CTCM I/7-8 p. 15 and CTCM I/3-4 p. 18 for details.

My response to this question is that if we defer translating "entropy" into order, and first develop a communication theory model of the bio-social system, and then examine the significance of maximizing negentropy of the model, we can arrive at a parameter which I first called "dynamic justice." It is a measure of the optimum balance between order and diversity in a social system.

Question 4: A reader of my prospectus issue, CTCM I/4-X, asks why I don't get a job working directly on the simulation of social systems at some university or research institute?

See CTCM I/7-8 p. 16(File 253 p. 16) for details.

I have two reasons for doing this research evenings and weekends as a 'week-end sociologist' rather than in a formal job situation: (1) I believe that there are still important benefits to be derived from the process of "technological meditation" described in CTCM I/1-2 pp. 19-21, and (2) the sociological uncertainty principle requires that I stay within the system that I am observing in order to make observations with the limits of accuracy that the uncertainty principle allows. For further details see above reference.

Question 5: A reader complained that the article "Perspective" in CTCM I/5-6 mentioned the existence of a youth drug culture without including a warning of the dangers of drug abuse.

I feel that the current social problems including the drug abuse problems are all related to the coincidence of a number of changes in our civilization which I characterize as a "sociological syzygy." For my analysis in these terms, see CTCM I/9 pp. 4-10(Files 99 p. 14 & 150 pp. 1-6).

Question 6: A reader says .."you use terms entropy, conservation, communication for classes of concerns that I call intellectual-systematic. I lean towards social and moral terms for classes of concerns that are emotional, motivational and spiritual (somehow systhesis with rational(scientific) concerns); social order, power, skill at winning, skill at brotherhood...."

For details see CTCM I/9 p. 3(File 99 p. 13).

I feel that when the principle of maximizing negentropy is carried to more practical examples, the relationship to Albert Schweitzer's principle of "reverence for life" will become more clear, and in turn provide for more communication with those who lean toward social and moral terms.

Question 7: Is there not a fallacy in the example comparing a dictatorship and a democracy in CTCM Vol. I, No. 5-6, p. 12 (File No. 111 p. 6) ?

Suppose one-third of the people in this hypothetical city-state believe that:	$2 + 2 = 3$;	$p_1 = 1/3$
another third believe:	$2 + 2 = 4$;	$p_2 = 1/3$
and another third:	$2 + 2 = 5$.	$p_3 = 1/3$

The negentropy of this philosophical system is:

$$H = - (p_1 \log_2 p_1 + p_2 \log_2 p_2 + p_3 \log_2 p_3) =$$

$$= 3 (1/3) 1.585 = 1.585$$

Next suppose that a scientist conducts some experiments that convince everyone that only $2 + 2 = 4$ is true, and the other equations are false.

Now, $p_1 = p_3 = 0$ and $p_2 = 1$, so that $H = 0$.

Is this not a contradiction, in that an advancement in knowledge is here characterized by a decrease in negentropy (increase in entropy) ? If the "thermodynamic imperative" is correct, we should be decreasing entropy (increasing negentropy).

Initial response: Where scientific experiment changes something from the domain of philosophy (speculative or probabilistic) to the domain of verified(or certain) knowledge, we need some measure of non-probabilistic information to properly explain the situation. As a first step to tackle this problem, let us define the non-probabilistic information(J) in this system as the number of bits of information known about this system. Each statement or equation for which we can say with certainty whether it is true or false counts as one bit of non-probabilistic information. The probabilistic information of the system is the sum of $- p_i \log_2 p_i$ for each statement or equation that is not known with certainty to be true or false(H). Then we define the total information (K) as the sum of H and J. The three tables following illustrate the learning process by which the population first is equally divided as to whether $2 + 2$ equals 2, 3, or 4. The second table represents the stage where the people are convinced that $2 + 2$ is not equal to 3, and the third represents the stage where they have become convinced that only $2 + 2 = 4$ is correct.

Statement	Stage I				Stage II				Stage III			
	p(x)	H_o	J_Π	K_x	p(x)	H_o	J_Π	K_x	p(x)	H_o	J_Π	K_x
a) 2 + 2 = 3	0.33	.528	0	.528	0	0	1.0	1.0	0	0	1	1
b) 2 + 2 = 4	0.33	.528	0	.528	0.50	0.50	0	0.50	1	0	1	1
c) 2 + 2 = 5	0.33	.528	0	.528	0.50	0.50	0	0.50	0	0	1	1
	1.00	1.585	0	1.585	1.00	1.00	1.00	2.000	1.0	0	3.000	3.000

Table 9.1 Information at Three Stages in Testing Hypotheses on Sum of 2+2.

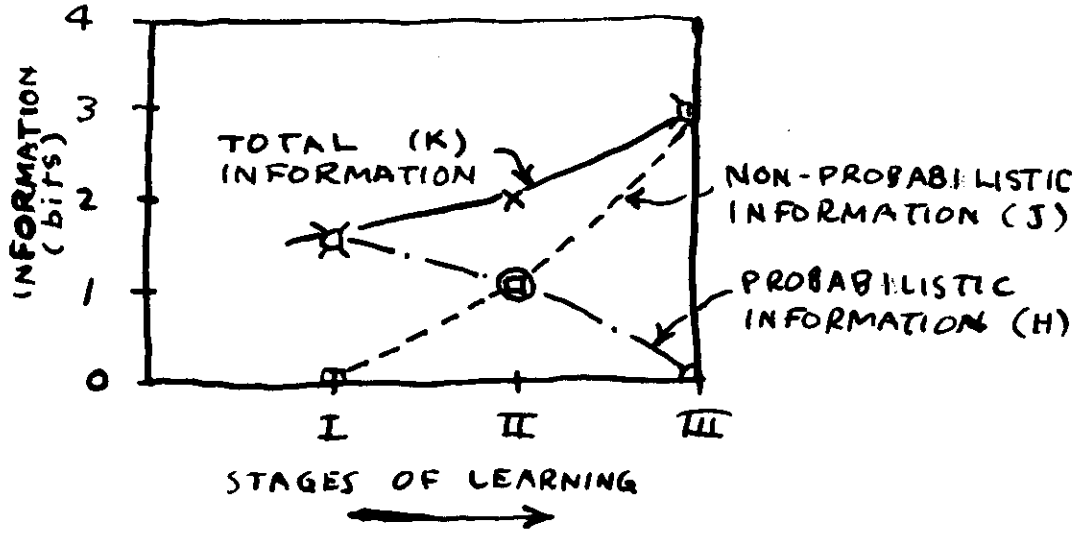


Fig 1 - Information at Three Stages of Learning 2+2=4.

Fig. 1 illustrates how the total information increases with learning, even though the probabilistic information decreases to zero in the example. At this stage I make no claim for generality of this concept of the sum of probabilistic and non-probabilistic information. There is a problem of units, since if we started with seven different equations for 2 + 2 and through a series of experiments learned that 2 + 2 = 4, the total information would be 7 bits compared to the above example resulting in 3 bits of information. It is obvious that in these two cases the significant thing learned is the same, namely that 2 + 2 = 4 and only 4. It is logical that both cases should result in the same amount of information being learned. A more rigorous theory may require some normalization of information units to solve this problem.

Question 8: Is it not dangerous from a humanitarian point of view for engineers to think about social problems ?

Now I have received some criticism that it is dangerous for engineers to think about social problems, in that engineers do not have the humanitarian background to understand social problems. I am acquainted with the facts that engineers like Georges Sorel did produce a destructive mixture of distorted Marxism, violence and fascism.(1) It has been my feeling for over ten years that if an engineer interested in developing a better understanding of our social problems maintains close contact with real problems of mathematics, engineering or computer science while working on social problems then the continued awareness of the necessity of completeness theorems in mathematics and philosophical problems such as complementarity in physics will force a proper consideration of the necessary human factors. I feel that it is the physcial scientist who leaves his home base of mathematics and/or engineering and moves entirely over to social systems who is the potentially dangerous "new utopian" of which Boguslaw gives us some warning.(2) Boguslaw presents a good survey of the potentials of systems theory, computer simulation, operations research, and other techniques for structuring social change to solve some of our pressing social problems. He also warns of the potential threat of these techniques for extending the control of man over man.

(1) J. L. Talmon, "The Legacy of Georges Sorel - Marxism, Violence, Fascism." Encounter, Vol. XXXIV, No. 2, Feb 1970, pp. 47-60.

(2) Robert Boguslaw, The New Utopians. Englewood Cliffs,N.J.: Prentice-Hall, Inc. (1965)

Question 9: A reader writes: "May I request a comment on the possible effects of future biological engineering? According to what I've read in Time and Esquire, it may in the not too distant future be possible to genetically alter the human body, e.g., four arms, no legs, etc.

What do you think might be the implications of creating a society of hermaphrodites? Really! I can readily see a marked lessening of egotism and materialism; a greater mobility for the individual; and a greater sense of community in such a populace. And, in such states as modern China, I can conceive of the political possibility of such a thing's occurrence."

Initial response: This question deals more with psychology than with my basic field of electrical engineering. I feel that my article on "Three Eras of Civilization" in CTCM Vol. I No. 7-8, Jan-Feb 1971, pp. 13-14(File 212 pp. 1-2) gives some background material for dealing with this question. Basically we are entering the "Communication Era" where the dominant technologies are communication devices. A corollary to this

is that more human communication is required to keep such a technological society human. This leads to the extension of human sex to assume a role in maintaining human communication in addition to the historical role of reproduction. I think that a discussion of the future role of human sex can be found in the book, Conduct of Sex, by Lawrence K. Frank, 1961, Morrow. I think that the creation of a society of hermaphrodites would be more likely to fail to meet the needs of the Communication Era.

Question 10: A reader has asked if I have sent sample articles from this series to someone like Angela Davis, who could review both the philosophical principles and the relevance to the real political world.

Preliminary response: At the time this question was asked the answer was no. Since then I have sent two sample issues of CTCM to Angela Davis with a covering letter pointing out a number of items upon which I would like comments.

Question 11: A reader asks how can I convince the board of directors of a corporation to use the concepts of cybernetics?

Preliminary response: This question stumps me. However, as a try, I suggest showing them some of Sorokin's curves of cyclic changes in history and Toynbee's table of the rise and fall of civilizations. Then ask them, if they want to collapse like the ancient Greek civilization or fall like the Roman Empire. Then ask them if they care to search for the saddle points in social evolution through which they could evolve to the next stage of society instead of being wiped out by revolution.

Further response: I think there is a related question that should be asked about revolutionaries and insurgents. How does one go about convincing the social revolutionaries that they could effect the social change they desire with less effort and in a more humanitarian way, if they learn the tools of cybernetics to understand the potential for social change in the social system in which they are in. An important thing to remember about the Russian revolution of 1918 is that V. I. Lenin coupled his social revolutionary ideas with an understanding of the transition from the Force Era to the Power Era. The core of Lenin's plan for bringing the Soviet Union into the Power Era was the Goelro plan for the electrification of the Soviet Union to provide for the electrification of industry and transport and to the employment of electricity in agriculture. On the other hand revolutionaries such as the Spartacans of Berlin in 1919 were wiped out in their futile effort to operate on a Force Era strategy.

Question 12: A reader challenges my concept of "technological meditation. He says this is nothing more than subconscious mental activity and represents nothing significantly new. (Relates to CTCM Vol. I, No. 1-2, Section 2.1.5)

Preliminary response: I agree that subconscious mental activity is the prime characteristic of what I call "technological meditation." However I think it is important that a special set of conditions that exist here be understood. All major civilizations in the past have at some time after their peak development reached a time of troubles and then taken a series of irrational actions leading to effective suicide for the civilization. A few people in strategic positions in these civilizations have, due to a combination of being intimately associated with the prime technology of the civilization and at the same time inclined to spend part of their time in meditation and to have subconscious mental activity, developed advanced insights as to the nature of the problems of their social system.

Usually these people in the past have been executed, exiled, or promoted to higher level jobs where they have less direct contact with the underlying technology of their civilization. Our civilization does the same thing, but often in a more pleasant manner, but usually achieves the same objective of reducing the probability of people having subconscious mental activity that might lead to the survival of their civilization. On account of the forementioned situation I think it is important to understand the special conditions which I label as "technological meditation." Technological meditation can be suppressed equally thoroughly by either killing off the technological meditators, or by giving them millions of dollars in research grants to administer.