COMMUNICATION THEORY in the CAUSE of MAN

Vol. I, No. 3-4

Reprinted Sept 1975

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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CONTENTS OF THIS ISSUE

'CTCM' COMMUNICATION THEORY in the CAUSE of MAN 'CTCM'

This periodical is scheduled to be published monthly and is planned so that each issue will constitute a section or chapter of a proposed book of the same title, "CTCM." The object of the proposed book 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 will be labelled with the volume and issue numbers of CTCM and with a "File Number." One may rearrange the pages of the cumulated issues by file numbers to put the sections in the order of the proposed book.

Frederick B. Wood

*** note: pgs. 3-4 omitted in Sept 1975 reprinting. For updated version of Section 1.0.1, see CTCM, Vol. II, No. 6-A.

NOTE ON REVISIONS AND ADDITIONS:

The '5' in File No. 100-F-5 indicates updating to June 7, 1970.
The '6' in File No. 100-F-6 indicates updating to July 12, 1970.
The '7' in File No. 100-F-7 indicates updating to August 30, 1970.
The '8' in File No. 100-F-8 indicates updating to October 4, 1970

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The editor wishes to thank the following publishers and/or copyright holders for their permission to reprint the material listed:

Addison-Wesley Publishing Co., Table for testing hypotheses from W. K. H. Panofsky and Melba Phillips, Classical Electricity and Magnetism, 2nd ed., ReadingMass, 1962. (File No. 214-F-8 p. 2)

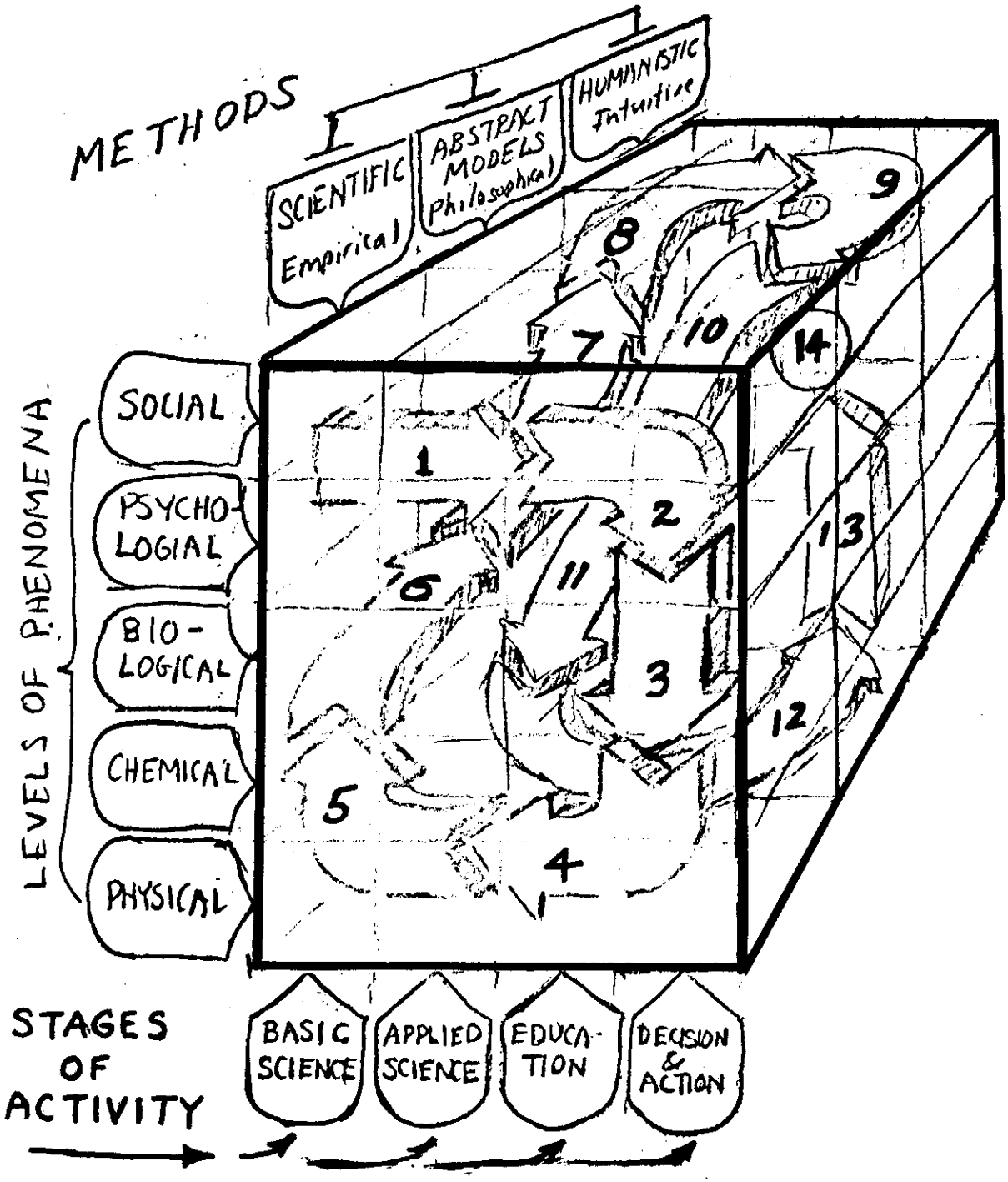
The editor wishes to acknowledge the source of non-copyrighted material as follows. It is the policy to notify the author or publisher of non-copyrighted material that is planned to be reprinted so that corrections or revisions can be made:

Society for Social Responsibility in Science, letter from SSRS Newsletter, No. 203, Oct-Dec 1969. (File No. 232-F-8 p. 4)

ERRATA:

File No./page/par/line	Correction
100-F-6/iv/3rd/6th	.....strategic place
121-F-5/2/fig. 2/caption	"(Based on a theory of Bryan P. Bergson)"
121-F-5/2/fig. 2/footnote	After "Time scale is logarithmic like HISTOMAP" add note: See John B. Sparks, THE HISTOMAP of RELIGION - The Story of Man's Search for Spiritual Unity, 1966 edn., published by Rand McNally & Co.

Are you concerned about the problems of our civilization? Do you think our civilization is doomed to collapse like ancient Greece and Rome? If you think our civilization has a chance of evolving into the next stage of social evolution, do you want to take an active part in guiding the social evolution? Do you like to experiment with facts and theories to see if you can construct more realistic hypotheses on how societies evolve? The chart below can be used as a guide to trace possible paths through the complex levels of phenomena we need to understand, the different methods we need to use in proper balance, and the stages of activity we need at different times in sequence in order to analyze and solve the complex problems of our civilization. The numbers refer to sample questions listed on the following pages.



How is your sociological imagination? Let us take an interdisciplinary trip in search of ways to attack the problems of human freedom and world peace. The numbers of the following statements and questions correspond to the numbers on the three-dimensional chart on the preceding page. The location of the numbers on the chart are located approximately on the intersection of the phenomenon, method, and activity stage involved for that part of the problem.

1. Let us use the modern version of charts (Ref. 1A) used by pioneer sociologists with the intellectual craftsmanship of C. Wright Mills (Ref. 1B).

2. Next let us look for applied sociology, as engineering is related to physics and chemistry. We only find incomplete attempts (Refs. 2Ah, 2Bh, 2Ch).

3. How can we find isomorphic laws and concepts tying together social, biological and physical phenomena which will enable us to develop the sociological engineering techniques needed to protect and develop peace and freedom? (Refs. 3A-C)

4. What empirical limits on electrical and human communication systems restrict the education process of applying new concepts? (Ref.4Ai)

5. What more fundamental process underlines all levels of phenomena?--
--negative feedback loops of cybernetics.(Ref. 5At, 5Be)

6. What does an engineering feedback loop look like and what is its behavior that has analogies in fields relevant to sociological studies? (Ref.6Ai, 6Bt, & 6Ce)

7. How do these negative feedback loops appear in psychology? (Ref. 7Ae, 7Bi)

8. How do these feedback loops determine the stability of economic and political systems? (Ref. 8Ai, 8Be) Automation & matrices?

9. Is there a fundamental ethical principle to which we can refer our sociological studies of peace and freedom? -- can we use Albert Schweitzer's concept of "reverence for life"? (9Ae)
Are we neglecting human values in the quantitative society?

10. What fundamental concept of physics and chemistry is most significant to the life process? --decreasing entropy (increasing negative entropy) (Ref. 10Ae)

11. Does the combination of Albert Schweitzer's ethical principle with Schroedinger's definition of the life process lead to a more rigorous equivalent of Immanuel Kant's "categorical imperative."? --- namely the "Thermodynamic Imperative." (Ref. 11Ae)

12. Does the "Thermodynamic Imperative" implemented with a discrete channel model from electrical communication theory give us a measure for comparing different social systems such as democracies and dictatorships? (Ref. 12At) Does this also give us a chance to find an ethical base for solving the population explosion problem?

13. Does a different model from electrical communication theory, namely the continuous channel, give us a measure of a balance between freedom and stability--"dynamic-justice"? (Ref. 13At)

14. Can we use this property of "dynamic-justice" and its associated political ideas distribution function to help us in international relations and in particular to aid in determining when disarmament is practical? What symbols or concepts will be the core of the ideology for the"information era" or the nöosphere?

In the course of developing the chapters outlined in Section I.O.I, we shall develop some tentative answers to these questions, and also establish methods of testing our hypotheses.

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2Ch. Fritz Pappenheim, The Alienation of Modern Man.(1959)

3Ah. Daniel Bell, The End of Ideology.(1960)
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3Ci. Colin Cherry, On Human Communication.(1957)
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11Ae. R..B. Lindsay, The Role Of Science In Civilization.(1964)
12At. F. B. Wood, "Negentropy and the Concepts of Freedom, Democracy and Justice," SEPR No. 88-B, Cleveland: A.A.A.S.-S.G.S.R. Meeting, Dec. 27, 1963.
13At. F. B. Wood, "A General Systems Theoretic Model For The Estimation Of The Negentropy Of Sociological Systems Through The Application Of Two Isomorphic Electrical Communication Networks," SEPR No. 93-B London: First International Congress of Social Psychiatry, August 19, 1964.

The last letter in ref. nos. indicates type:

"h" = historical
"e" = elementary
"i" = intermediate
"t" = technical

ALLOCATION OF SUPPLEMENTARY PUBLIC EXHIBIT SPACE BY NEGENTROPY OF MEMBERSHIP STATISTICS.

My concern over church meeting and exhibit space comes from a series of experiences since World War II principally in California in which churches have been forced out of strategic locations through the state's use of eminent domain for expansion of schools and freeways. Juries and local judges understand financial injustices easily and thus have corrected any unfair awards in regard to the monetary compensation. The location of the principal churches and synagogues in strategic points around central parks, squares, and civic centers used to be a symbol of the role of the religious organizations in helping man develop a conscience and to look forward from the past struggles toward a better more just society. Even though some of the churches may be a generation behind in adjusting to the advances of modern science, discussions of the problems of our civilization in church discussion groups serves an important role in developing understanding of the problems of our civilization.

The economic trends and city planning policies of large American cities result in the 'socialization' of an increasingly larger fraction of the property in the center of our cities. Public buildings and freeways eat up the land area in the centers of our large cities, while skyscrapers shield the remaining central squares from general view. If a new religious group should develop in a typical large American city, it would have a very difficult time acquiring a strategic site for their central temple. We may have a conflict between the principle of separation of church and state and the guarantee of religious liberty when the percentage of publically owned property in the centers of our cities exceed a certain fraction.

When this level of 'socialization' exceeds a certain critical fraction, it may be necessary for the state or city to allocate supplemental space in the form of bulletin board space in a central square or civic center to different religious and philosophical groups. The purpose of this memorandum is to explore a hypothesis that the concept of negentropy from electrical communication theory can be used as a guide in such circumstances for determining the ratios of supplemental space to allocate to each religious group.

The reason for considering "negentropy" rather than some other property for a guide in this allocation of space is that there is a loose relationship between maximizing negentropy and an ethical principle of "reverence for life." The analogy can be seen partially by noting how biological systems preserve or increase order, thereby decreasing entropy(or increasing negative entropy).

Reviewing the situation of a city that has been cut up by freeways and in which the original center formerly holding the central core of principal churches has been shrunk by expansion of a college and by schools and public buildings. The churches which have been eliminated can be found relocated out in the suburbs, with the exception of the largest denominations. The diversity of religious belief of the city no longer can be seen at a glance as one stands in the center of the city.

Consider a hypothetical city of 100,000 adults (children not counted in this study). The assumed distribution of adult members of different religious faiths is as listed in Fig. 1. It is assumed that each religious group has bulletin board space as indicated on its church property, but visible from the public street. For some locations the bulletin board may be in a strategic place, but for others it may face on a side street in a suburban area and the church may be obscured from view by a freeway and a set of skyscrappers. We shall experiment with a way to allocate supplemental bulletin board space in a public building or public square to guarantee that all religious groups have some prime public bulletin board space for the benefit of their own members, visiting members of their faith from out of town, and to be a symbol of the cooperative existence of differing faiths in a democratic community.

Table 1

Religious Group	Members	p_i Prob.	$-p_i \log_2 p_i$ Negentropy	Bulletin Bd. Space Private	Public	Total
1. Roman Catholic	60,000	0.600 0	0.441 0	6,000	4,420	10,420
2. Protestant	20,000	0.200 0	0.463 0	2,000	4,630	6,630
3. Lutheran	15,000	0.150 0	0.411 0	1,500	4,110	5,610
4. Protestant Episcopal	3,000	0.030 0	0.152 0	300	1,520	1,820
5. No Church	1,000	0.010 0	0.066 5	100	665	765
6. Budhist	600	0.006 0	0.044 3	60	443	503
7. Unitarian	230	0.002 3	0.020 2	23	202	225
8. Jewish	100	0.001 0	0.009 96	10	100	110
9. Eastern Orthodox	60	0.000 6	0.006 4	6	64	70
10. Catholic Ethical Culture	10	0.000 1	0.001 33	1	13	14
	100,000	1.000 0	1.616 7			

The results of a sample calculation are tabulated in Fig. 1. The supplementary public bulletin board space is taken proportional to the negentropy of the membership statistics. In addition the privately owned bulletin space and the total values are tabulated. These values are drawn graphically to scale on the bottom part of Fig. 1. Suppose that a 100' x 30' section of the main lobby of the civic center building is devoted to exhibit space consisting of a four foot wide section of bulletin board around the lobby. Then 16,167 unit squares of space would correspond to 1040 sq.ft,. making each unit be 9.4 sq.in. This makes the smallest group (No. 10, Ethical Culture) have 13.3 units or 116 sq. in. or one legal size sheet of paper. If one individual developed some new philosophy, by the negentropy formula, he would be entitled to the space of one third of a page space to state in one paragraph his cause and to give his address, phone, etc., for further details.

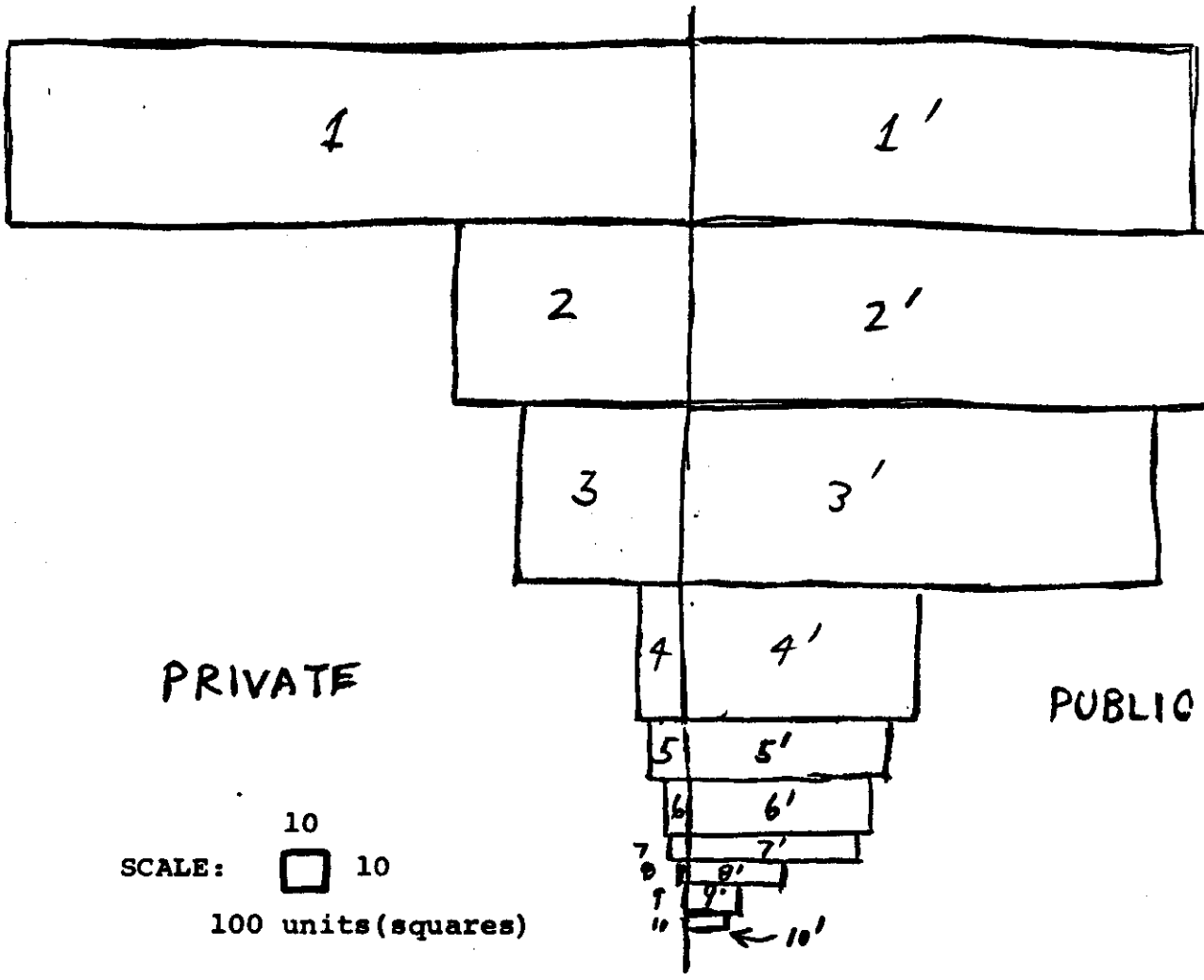

Fig. 1. Sample Distribution of Private and Supplemental Public Exhibit Space Determined by Negentropy of Membership Statistics

In order to test the hypotheses discussed in this series of papers, such as the "thermodynamic imperative," the theory of the socio-metabolic transition, applying the concept of negative feedback loops to many problems, and allocating communication space in proportion to the negentropy of membership statistics, we must examine how hypotheses are tested in the physical sciences.

Many fundamental laws of science have not been derived from more basic laws. For example Maxwell's equations cannot be derived directly from more basic postulates. Similarly the Einstein Special Theory of Relativity cannot be directly proved. Professor Panofsky's examination of the status of how we check hypotheses like the Special Theory of Relativity can give us some clues as how to attempt to test our hypotheses.

Table 1 *illustrates how Professor Panofsky demonstrates how one can examine the Special Theory of Relativity and competing theories to determine which is an acceptable hypothesis.

Theory		Light propagation experiments							Experiments from other fields					
		Aberration	Fizeau convection coefficient	Michelson-Morley	Kennedy-Thorndike	Moving sources and mirrors	De Sitter spectroscopic binaries	Michelson-Morley, using sunlight	Variation of mass with velocity	General mass-energy equivalence	Radiation from moving charges	Meson decay at high velocity	Trouton-Noble	Unipolar induction, using permanent magnet
Ether theories	Stationary ether, no contraction	A	A	D	D	A	A	D	D	N	A	N	D	D
	Stationary ether, Lorents contraction	A	A	A	D	A	A	A	A	N	A	N	A	D
	Ether attached to ponderable bodies	D	D	A	A	A	A	A	D	N	N	N	A	N
Emission theories	Original source	A	A	A	A	A	D	D	N	N	D	N	N	N
	Ballistic	A	N	A	A	D	D	D	N	N	D	N	N	N
	New source	A	N	A	A	D	D	A	N	N	D	N	N	N
Special theory of relativity		A	A	A	A	A	A	A	A	A	A	A	A	A

Legend: A, the theory agrees with experimental results.
D, the theory disagrees with experimental results.
N, the theory is not applicable to the experiment.

Table 1

* Reprinted with permission from W.K.H. Panofsky and M. Phillips, CLASSICAL ELECTRICITY AND MAGNETISM, 2nd edn., Copyright © 1962, Addison-Wesley, Reading, Mass. All rights reserved.

** This section abstracted from material presented in a talk: Frederick B. Wood, "A Comparison of the Complexity of Testing Thematic Hypotheses in the Physical Sciences and the Social Sciences." Society for General Systems Research, Section L-3: History and Philosophy of Science at American Association for the Advancement of Science, December 27 1965, Berkeley.

Replaces File No. 214-F-5 and 214-F-7.

Panofsky has tabulated the competing hypotheses on the relationship of the laws of mechanics and electromagnetic theory in Table 1 in seven rows. He has listed fourteen experiments in the fourteen columns in Table 1. He has then marked each square in the table with a 'A, D, or N,' -- to indicate whether the theory agrees, disagrees, or is not **applicable** to the experiment.

If we **examine** Table 1 more carefully, we see that each of the three ether theories have from two to three experiments where the theory disagrees with experimental results. Similarly with the emission theories. It is only with the bottom row for the special theory of relativity that we find agreement with every experiment. This analysis does not prove that the special theory of relativity is correct. It only demonstrates that the theory agrees with the known experiments as of 1962. Since the other theories are not consistent with all the known experiments, most scientists accept the special theory of relativity as the best explanation **of the relationship between electrodynamics and mechanics at high energy levels. Perhaps some day an experiment will be performed that shows a conflict between the special theory of relativity and the observed experiment. When that happens we will have to search for a more general theory.**

Now it is my aim to lay the groundwork for the construction of tables of the correspondence between theory and experiment(or historical facts) for sociological theories. At this stage I can construct a tentative table, but am not certain enough of the methods of testing hypotheses in **sociological** phenomena. Therefore for this edition, I shall leave the squares in the table blank. I plan to fill in squares **in Table 2** in later issues of CTCM.

In testing sociological theories, the social scientists are part of the social systems being observed, and hence cannot necessarily be really impartial observers. Therefore we have to think of what additional tests can possibly be developed. In Table 2,I have provided a column for deductive logic derivation. It may not be possible to fill this column in completely, but it is **important that we search for any possible** deductive reasoning.

Next it is desirable that we find any inductive reasoning that is applicable. For example, are there similar forms of physical, chemical, biological, **psychological**, and social phenomenon that help us derive **by** induction a plausible hypothesis?

Now we come to empirical and experimental tests. For social phenomena, the first source is historical tests. Next we have questions as to whether a given theory is useful in resolving problems of allocation of communication space in a social system. Then we have a group of social parameters to measure. Do the different theories help us measure these parameters?

Then we have some key social problems to test whether the different theories are useful in maintaining a suitable perspective of what is happening in the areas of population explosion, changing concept of justice, and disarmament problems. Next it is important to know whether the competing theories help in developing suitable strategies in the areas of political ideology and ethics-coordinating principles.

TABLE 2: BLANK CHART FOR TESTING SOCIAL HYPOTHESES

LOGICAL TESTS & EXPERIMENTS / THEORIES	DEDUCTIVE	INDUCTIVE					EMPIRICAL & EXPERIMENTAL TESTS																		GROUP
							Historical				Allocation						Measures		Problems			Strategies		Control	
	Deductive Logic Derivation	Physical	Chemical	Biological	Psychological	Sociological	Hindu Social Cycles	Aristotle's Gov Stages	Sorokin's Social Cycles	Toynbee's Civilz. Cycls	Library Shelves	Bulletin Boards	Meeting Space	Radio & TV Time	Computing Power		Measure of Democracy	Monitor Econ Devlpmt	Eval Military Policies	Population Gwth Cntrl	Disarmament Conditions	Political Ideology	Ethics Coordinating Principle	Capability of Democratic Control	
MIGHT MAKES RIGHT																									I.
REVOLUTIONARY GUERILLA WFR																									
CIVILIZATION LIFE CYCLE																									
TERRITORIAL IMPERATIVE																									
MARXIST EVOLUTION SOCIALISM																									II.
STRUGGLE: CAPITLSM - SOCLSM																									
ESCALATION OF POWER																									
THERMONUCLEAR WAR STRATEGS																									
ECONOMIC GROWTH THEORY																									
TRAGIC DILEMMA THEORY																									
WORLD LAW THRU LEAD POWER																									
AUTONOMOUS ECON DEVELOPMT																									
WORLD LAW THRU COMMUNICTN																									III.
PACIFIST ETHICAL ACTION																									
THERMODYNAMIC IMPERATIVE:																									
MODIFIED: WITH DISCRETE CHAN MODEL																									
MODIFIED: WITH CONTINUOUS CHN MDL																									
MODIFIED: WITH CYBERNETIC FDBK LPS																									
MODIFIED: WITH FUZZY SETS																									
MINIMAX NEGENTROPY ALLOCTN																									
SOCIO-METABOLIC TRANSITION																									
EPICOSM MODELS																									

CTCM Vol. I, No. 3-4 P. 15
File No. 214-F-8 P. 3

The final test of an applied sociological theory is whether institutions derived from it are capable of being democratically controlled by the people. A very efficient social system run by an elite group of strategists might not maintain the best interests of humanity at heart. It would be better to develop a system that is accesible to control and understanding by the educated layman.

The testing of hypotheses in the social sciences is more complex than in the physical sciences. Another level of complexity is that different social theories may be relevant in different stages of social evolution. I have not attempted to show this complex feature in Table 2. At some time in the future we may have to change Table 2 from a two-dimensional table to a three-dimensional table to account for the change in relevance of a given theory as time spirals on. Some hypotheses may be valid in the force era, but not in the power era. Other hypotheses may be valid in the power era, but invalid in the information era. For a glimpse of the significance of the force era, power era, and information era -- see Fig. 1 in Section 1.2.1 on Civil Rights and Evolution.

In Table 2, I have tentatively marked the different theories as belonging to Groups I, II, or III on the basis of my first guess as to whether the theory is more relevant to the Force Era, Power Era, or Information Era. As we develop more detailed analyses we may have to revise these. Some theories may be of equal relevance in two groups or eras.

Dr. Lindsay later published a book with a chapter on the "thermodynamic imperative." This later reference is The Role of Science in Civilization (Harper & Row, 1963). Here Dr. Lindsay goes into more details of the background of information theory and thermodynamics and then develops the same definition:

> "All men should fight always 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. (p. 212.)

The above thermodynamic imperative is illustrative of the kind of ethical concept that can be derived by analogy from the science and mathematics at the base of our technological society. However I feel that Professor Lindsay, in translating the word entropy into order for the layman, has lost part of the meaning. When one uses a communication theory model to implement Lindsay's thermodynamic imperative, it becomes apparent that "increase the degree of order" should be replaced by "optimize the order-diversity balance", and that after disorder in the second from the last line, one should insert "and diversity to be transformed into conformity." Thus the use of an electrical communication theory model makes the thermodynamic imperative a more useful hypothesis.

Section 2.3.2B: Letters on the Thermodynamic Imperative

B. P. Bergson, San Jose, California, has written: ".... However, I can't stomach the "Thermodynamic Imperative." The logical conclusion is that the best of all possible worlds is a 100% mosaic structure. If you have spent any time in the armed forces, you surely will understand what would be wrong with living in a perfectly Ordered system. I hated it. With all its confusion and chaos, I much prefer the equipotential society over the mosaic.

Sincerely,
Bryan

P.S. 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. Lindsay didn't consider that, did he?
B.P.B.

I made reference to the "Thermodynamic Imperative" in two articles, one in MANAS, Vol. XVIII, No. 17, April 28, 1965, Manas Publishing Co., P.O. Box 32112, El Sereno Station, Los Angeles, Calif., 90032 and the second in SSRS Newsletter, No. 195, January 1969, Society for Social Responsibility in Science, 221 Rock Hill Road, Bala Cynwyd, PA 19004.

An important letter critical of the "Thermodynamic Imperative" is reprinted on the right from SSRS Newsletter.

My response to these criticisms is to note that in Section 2.3.2A I have proposed a modification to Lindsay's "Thermodynamic Imperative," and further to state that it requires some kind of a model to use with the "Thermodynamic Imperative" in order to apply it to a practical case. In the next section I give an example of using the continuous channel model from Information Theory to relate the "Thermodynamic Imperative" to some practical problems.

F.B.W.

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SSRS NEWSLETTER

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LETTERS

To the Editor:

Referring rather belatedly to an item in the SSRS Newsletter way back in January, 1969 (p.4), I should like to add some qualifying remarks to the following quotation by F. B. Wood of Prof. Lindsay's "Thermodynamical Imperative."

"All men should fight always 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."

To me, the call for maximization of the degree of order in every man's environment has too much of an American (or should I say, Scientific) flavor. To infer from Nature's drift towards more entropy (i.e. more probable states), that the interests of mankind are best served by artificially creating as much order as possible (or rather, to be consistent, states as highly improbable as possible) – to do so means to forget that man is himself a part of Nature, that he has only just transformed himself from a creature dominated by natural forces into a (relative) master of Nature. Above all, he has certainly not yet succeeded in becoming a master of his own nature to a sufficient degree to feel at home in a completely artificial environment; if his conscious self does through training, his unconscious nature will more often than not revolt, via neuroses, etc.

It is true that the more "primitive" instincts in man tend to increase the amount of entropy in his surroundings, notably by killing and destruction. However, with the advent of civilization and the industrial revolution, more and more improbable things were being created, both tangible and intangible, most of them with the help of Science; and it is one of the principal worries of bodies like the SSRS that we are heading for the day when the world around us will become just that little bit too artificial. The citizens of the United States, for example, could easily create their quota of Order by converting one half of their country into wheat fields and the other, into a vast structure of industrial sites, office blocks, suburbs, and superhighways (which according to some they are about to do anyway).

Surely this cannot be what "all men should fight for as vigorously as possible." It is not by chance that in some of the gloomier science fiction fantasies, ORDER is the password for all days, with human society behaving like a deterministic machine and everybody dancing to the same tune like atoms in a crystal. Surely there must be something else besides Order which we should try to maximize. Admittedly order will have to be an ingredient of any conceivable measure of desirability, but it is a necessary condition and not a sufficient one.

Suggestions for further constituents are open to argument; what they will have to add up to is a maximal degree of something which for want of a better term might be called Harmony, namely, a harmony both between Man's nature and Nature's nature, and between one man's nature and everyone else's. The pity is we don't know a measure of Harmony yet.

Helmut Richter
Frankfurt a.M., Germany

Draft of Proposed Letter to MANAS for response to letter of Clear Marks, San Diego, Calif.

Dear MANAS,

A recent letter from a fellow reader of MANAS, Mr. Clear Marks, said Murrieta's quote (MANAS, April 28, 1965) from R. B. Lindsay seems to glorify orderliness for its own sake. Mr. Marks then gives his own imperative as follows:

> "Let's tolerate random disorder where it does not limit our growth; let's create order where order accelerates our growth; and let's dare to explore our limits of creating orderliness in those areas which we feel most worthy of us."

I am in essential agreement with Mr. Marks. The communication problem here is that I believe Professor Lindsay tried to use a less technical word than entropy. In his paraphrasing for the layman, the use of the word order as equivalent to negative entropy lost part of the meaning.

Now in my letter to MANAS, I did not use the word order except in the quote from Lindsay. I used the word "entropy" in reference to my own ideas, and said that I had not yet learned how to translate these ideas into suitable language for the educated layman. Stimulated by exchange of letters with a number of people, I now have a way I would revise R. B. Lindsay's "thermodynamic imperative:"

'MODIFIED THERMODYNAMIC IMPERATIVE'

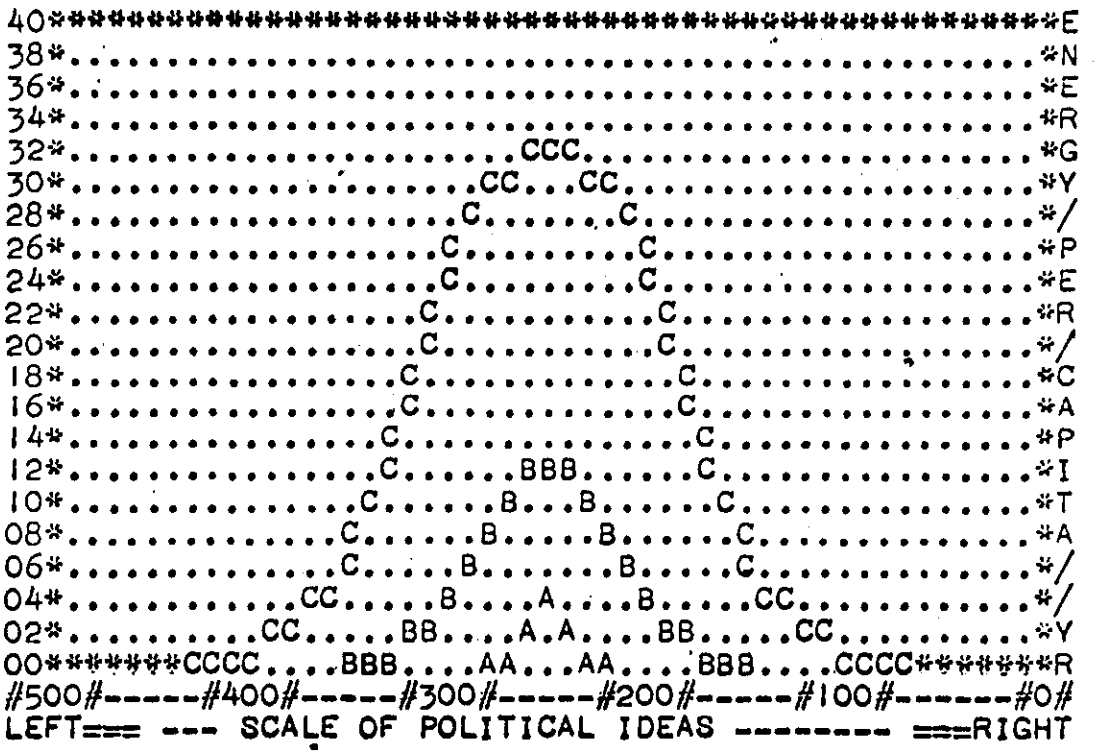
> All men should fight always as vigorously as possible to optimize the order-diversity balance in their environment, i.e., consume as much entropy as possible, in order to combat the natural tendency for entropy to increase and for order in the universe to be transformed into disorder, and diversity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

This change from "order" to a balance of order and diversity comes from (1) contracting R. B. Lindsay's "thermodynamic imperative" to eliminate the phrases using the word "order", i.e., using only the word "entropy," and (2) interpreting what consuming entropy means by use of a model from electrical

communication theory.

A similarity in the curves of output rate versus the input rate of information in telephone wires on one hand with those for a series of biological systems on the other hand such as the optic nerve, the processing of optical information in the brain, decision making by individuals, groups, and social institutions led me to examine more carefully possible analogies between electrical communication systems and sociological systems. What is known as a continuous channel as defined by Claude Shannon in The Mathematical Theory of Communication (University of Illinois Press, 1949) offers us an interesting analogy for the study of sociological systems. I have found that a specific model is needed to be able to interpret general principles such as the "Modified Thermodynamic Imperative." In order to determine whether we are going in the right direction to "consume entropy" we must define a way to measure the entropy of the sociological system. Claude Shannon's continuous channel gives us mathematical formulas with which we can measure the entropy of a set of messages sent over a telephone line. If we can define a series of political ideas or philosophies which have a similar relationship to a sociological system as a set of messages have to the telephone line over which they are sent, we might be able to apply similar formulas for the entropy of the sociological system.

When we try this analogy for a country at three stages of its development, namely stages A, B, and C corresponding to power production of 256, 1024, and 4096 kilowatt-hours per capita per year, we obtain the three curves drawn by the letters A, B, and C respectively in the block below:



These curves show that the "modified thermodynamic imperative," when implemented with the continuous channel model predicts the above curves as optimum distributions of power among people of different political philosophies. This means that the theory predicts it is optimum for a country at the low level of 256 kwh/cap/yr(curve A) to tolerate only a small diversity in political philosophy in order to concentrate on a specific plan to industrialize the country. As the country increases its industrialization to the level of 1024 kwh/cap/yr (curve B),its tolerance of a diversity of political ideas should

broaden. As the energy production increases to 4096 kwh/cap/yr (curve C) we note an even broader spread of the bell-shaped curve.

This implementation of the "modified thermodynamic imperative" with a specific model, even though it is an analogy borrowed from electrical engineering, gives hope of providing the base for a democratic ideology that can work for a more democratic society, for Albert Schweitzer's "Reverence for Life," and for a society oriented toward a more human principle of love, instead of accepting the trend for conformity and authoritarianism observed and accepted by many of our social scientists as the wave of the future.

For those who wish to explore these concepts in more depth without getting deep into mathematics, there are two books which are now available in paperback editions which have sections relating to some of these points: Colin Cherry, in his book On Human Communication (Science Editions, paperback, John Wiley & Sons, 1962) discussed continuous information in pages 188-196, and gives the equation for the entropy of a continuous noiseless source on page 215; and D. A. Bell in Intelligent Machines - An Introduction To Cybernetics (Blaisdell Scientific Paperback, 1962) gives a discussion of entropy as a measure of diversity and the advantages of disorder on pages 85-90.