VOL. II NO. 6

PART A

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.

Frederick Bernard Wood, Ph.D., Publisher
P.O. Box 5095, San Jose, Calif. 95150
U.S.A.

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Level A, September 1961
Level B, February 1965
Level C, January 1966
Level D, Janyary 1967
Level E, January 1968
Level F, June 1970

NOTES ON REVISIONS TO CTCM:

CTCM Update Level No.	In File Number	Indicates Updating to Date
7	100-F-7	August 30, 1970
10	098-F-10	March 28, 1971
14	097-F-14	March 5, 1972
17	097-F-17	January 1, 1973
20	397-F-20	September 16, 1973

In July (1973) I announced that this issue of CTCM (Volume II, Number 6-A) would be distributed in September 1973 and that also the loose-leaf book, COMMUNICATION THEORY in the CAUSE of MAN, consisting of all the back issues of the magazine for Volumes I and II, reorganized into the form of a book, would be available in September. The material for this issue was practically complete on September 9th and some of the material was already at the printers. I got to thinking about the Society for General Systems Research Western Regional Meeting planned for September 13-15 in Long Beach. This meeting was to be a departure from the usual sessions of contributed papers. The plan was for all workshops to spend their time making lists of the different theories proposed in their aspect of general systems theory, then make lists of the tests and criteria for evaluating different candidates for a general systems theory. I decided to delay this issue of CTCM and also the book until September 16, the day after the S.G.S.R. meeting to allow for minor changes in the event that anything significant came out of the S.G.S.R. meeting. I was particularly interested to see if anything came out of the start made at last year's meeting by R. Rendle Leathem's comparison of twenty-two general system theorists in the paper, "General Systems Trends and the Future," S.G.S.R. Regional Meeting, Portland, Oregon, September 1972. (For abstract or reprint address R. Rendle Leathem, Huckleberry Hill, Lincoln, Massachusetts 01773.)

Two important things occured on September 14 at the S.G.S.R. meeting. First, Workshop Session A organized by L. R. Troncale and B. P. Bergson on "Relating Existing Systems Theories: How to 'Test' Hypotheses in Meta-Theories," identified twenty-seven different theories or methodologies to be tested as candidates for "general systems theories." This workshop also defined twenty-eight tests or questions for use in checking the validity of a candidate for a general systems theory. On the second day of the conference this workshop succeeded in filling in tentative data on six rows of the 27 by 28 matrix for testing hypotheses. The second important event was the message given by the president of S.G.S.R. at the dinner meeting, Dr. James G. Miller, who is also the president of the University of Louisville in Kentucky. Dr. Miller stressed that it is time we had less talk and more data. He said that many general systems people continue to talk about their own ideas without critically evaluating them in comparison with other theories. Furthermore there is insufficient testing of general systems concepts against observable data.

After the S.G.S.R. meeting, I decided to do something to help speed up the process of comparing and evaluating different candidates for a "general systems theory" by revising this issue of CTCM to include as a start an analysis of where my approach and the other six systems considered in the workshop matrix relate to the overall development of general systems theory. I decided to delay this issue of CTCM, in order to include Section 1.0.9 showing the general relationship of these different candidates for a general systems theory. This necessitated the postponement of other material to a future issue, and the juggling of page numbers to minimize the delays to the release of the book.

I have received a few letters from people who have seen single issues of the magazine, CTCM, saying it is difficult to follow this format and double numbering of pages. To respond to this problem, I am experimenting with including a single "blue sheet" in this issue which summarizes the objectives of this magazine and includes an abridged outline of the book.

This issue of CTCM is the last issue of Volume II. It is being issued in two parts. Part A is the regular material of CTCM. Part B is a supplement not included in the regular subscription price. Part B is a kit of a loose-leaf binder, set of index tab spacers, and special pages for reassembling the issues of CTCM of Volumes I & II into a loose-leaf book. Starting with Volume III, CTCM will be published quarterly with an annual supplement included in the subscription price. It is planned that the annual supplement will summarize the work reported in CTCM and also include material for updating the loose-leaf book.

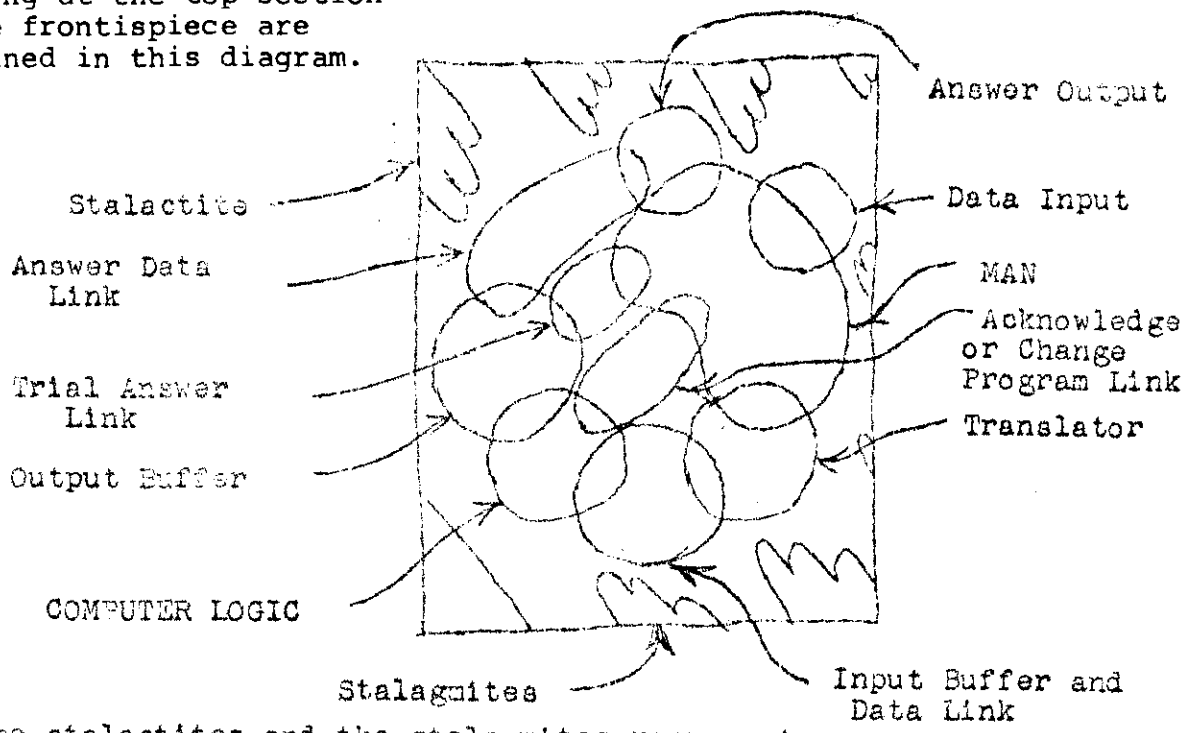
To those of you who have ordered copies of the book, COMMUNICATION THEORY in the CAUSE of MAN, I wish to apologize for the delay. However I think it is important, in that this delay may lead to a better understanding of how this method of applying communication theory relates to the more general problem of developing a truly general systems theory, while providing some advance insights on how these concepts can be applied to help protect and develop democratic institutions for the benefit of the people.

Frederick B. Wood

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 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.

Additions and Corrections:

CTCM Vol. II, No. 6-A, p. 7
File No. 100-F-20 p. iiB
(Replaces 100-F-17 p. iiA, II/3)

File No./Page/Par/Line	Addition or Correction:
100-F-17/i/par below title box	To assemble a copy of the loose-leaf book, CTCM, unstaple a complete set of the magazine, CTCM, issued to date and reassemble the sections by "File Numbers," except for the magazine title pages and editorial notes. Consult CTCM,Vol.II, No. 6, Part A, Section 1.0.1 (File No. 101-F-20) for suggested way to file individual-issue title pages and irregular pages. A supplement to this issue of the magazine is available for $3.00, which includes a binder, tab-spacers, auxiliary pages, and instructions for assembling the back issues into a loose-leaf book.
100-F-17/iA/1st section	COPYRIGHT NOTICES AND ACKNOWLEDGEMENTS: Add the following: © 1973 by FBW: CTCM Vol II, No. 4, 5. © 1973 by FBW: CTCM Vol II, No. 6, Part A.
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.

ERRATA

CTCM Vol. II, No. 4, p. 6: 4th par., 5th line, 4th word should be:
"syzygy"

ACKNOWLEDGEMENT OF PERMISSION FOR USE OF COPYRIGHTED MATERIAL:

For permission to use the items reprinted in CTCM II/5 pages:	Acknowledgement is made to the following publisher for permission granted:
pp. 18-22 Article by Frederick B. Wood	The HarBus News for article in CAREERS AND THE MBA 1969.

CTCM II/6A p. 6 is blank

An improvement can be made in the assembly of the end cover on the loose-leaf binder provided with CTCM Vol. II., No. 6-B:

The end cover will stay more securely in place, if holes are punched as shown on the right, instead of cutting the notches originally specified.

COMMUNICATION THEORY in the CAUSE of MAN © f.b.wood

Designed for use with Wilson-Jones Nylon Post Binder No. 14-118 N or 14-118 NJ

This "blue page" is included to help the new reader of CTCM who hasn't read the preceding issues to get a perpsective of the series.

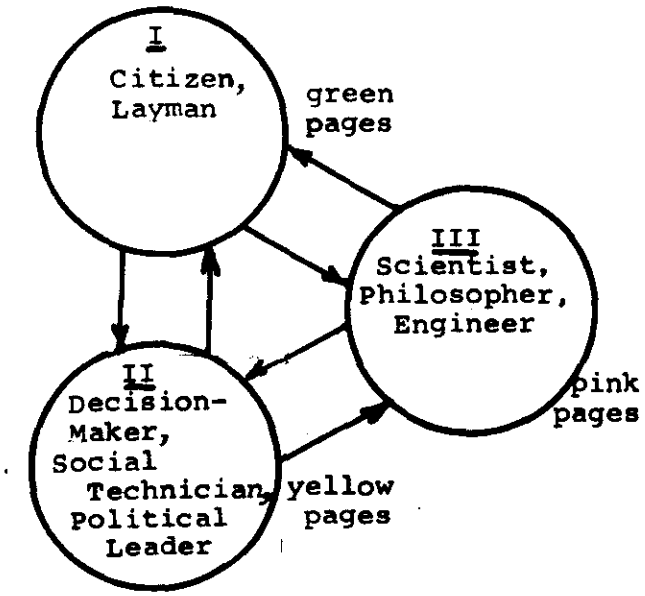
Magazine 'CTCM' — COMMUNICATION THEORY in the CAUSE of MAN — Book 'CTCM'

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 CTCM, 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:

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

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

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

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

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

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

This outline indicates the order in which sections of the issues of the magazine COMMUNICATION THEORY in the CAUSE of MAN issued to date can be reassembled by File Number in order to make a loose-leaf book.

Section	Subject	Book Sequential File Nos./Pages	Magazine CTCM Nos./Pages
	Loose-Leaf Binder for 8.5 x 11 sheets(Wilson-Jones # 14-118 N or # 14-118 NJ or equivalent)	. . . . .	II/6B
	End Cover & Label with Instructions	End & Cover of Binder	II/6B
	Frontispiece	To Be Glued Inside Front Cvr	II/6B
1.0.0	Title Page	100-F-17 i	II/3 5
	Copyright Notices & Acknowledgements	100-F-17 iA-iB	II/3 6-7
	Explanation of Frontispiece Figures	100-F-20 ii	II/6A 5
	Additions and Corrections . .	100-F-20 iiB-iiC	II/6A 7-8
White Tab Spacer "Magazine & Book Prefaces (100).		100-F-20 iiD	II/6B
1.0.0	1970 Preface to First Issue of The Magazine COMMUNICATION THEORY in the CAUSE of MAN .	100-F-19A iii-iv 100-F-6 v-vi 100-F-5 vii-viii	I/1-2 5-6 I/1-2 7-8 I/1-2 8A-8B
1.0.0B	"Blue Page" Project Summary .	100-F-20 xv-xvi	II/6A 9-10

Title Pages and Editorial Notes from Individual Issues of the Magazine CTCM have been moved to Section 3.9.7 near the end of book.

Green Tab Spacer "Table of Contents & Book Outline" (101)		101-F-20 0	II/6B
1.0.1	Outline of Loose-Leaf Book COMMUNICATION THEORY in the CAUSE of MAN	101-F-20 1-11	II/6A 11-21

BOOK ONE: INTERPRETATION OF CYBERNETICS, GENERAL SYSTEMS THEORY, AND INFORMATION THEORY FOR THE CITIZEN-LAYMAN.

(GREEN PAGES)

BOOK TWO: APPLICATION OF PRINCIPLES OF CYBERNETICS, GENERAL SYSTEMS THEORY, & INFORMATION THEORY TO PRACTICAL PROBLEMS. -- WRITTEN FOR THE SOCIAL TECHNICIAN AND SYSTEMS ENGINEER.

(YELLOW PAGES)

BOOK THREE: MATHEMATICAL AND SCIENTIFIC BACKGROUND, TESTING OF HYPOTHESES -- PRIMARILY FOR THE PHILOSOPHER AND SCIENTIST. (PINK PAGES)

Section	Subject	Book Sequential File No./Pages	Magazine CTCM Vol/No
	3.3 STATUS OF ENTROPY AND INFORMATION		
3.3.0	Status of Entropy and Information In The Physical, Biological and Social Sciences	330-F-5 1-2	I/1-2 27-28
	3.4 INFORMATION THEORY		
3.4.1	Tables and Curves of Uncertainty and Negentropy	241-F-14 1-2	I/12 9-10
	3.5 CYBERNETICS		
	3.6 SIMULATION		
	3.7 PHYSICAL SCIENCE		
3.7.1	Thermodynamics	371-F-19 1-2	II/5 27-28
	3.9 BIBILOGRAPHY, NOTES & INDEX		
3.9.4	Book and Report Reviews	394-F-11 1-2 394-F-12 3 394-F-19 5-6	I/7-8 17-18 I/9 17 II/5 29-30
3.9.6	List of Questions and Discussion of Hypotheses		
	(Questions 1-12)	396-F-14 1-7	I/12 11-17
	(Questions 13-18)	396-F-15 9-11	II/1 25-27
	(Questions 19-23)	396-F-17 13-15	II/3 25-27
	(Question 24)	396-F-18 17	II/4 27

Section	Subject	Book Sequential File No.	Pages	Magazine CTCM No.	
Pink Tab Spacer	"Editorial Notes from Magazine" (397)	397-F-20	0	II/6B	
3.9.7	File of Title Pages and Editorial Notes from Individual Issues of the magazine CTCM.	397-F-18	0	II/4	29
	TITLE PAGES AND EDITORIAL NOTES FROM INDIVIDUAL ISSUES OF THE MAGAZINE: CTCM.				
CTCM:					
	Vol. I, No. 1-2, June-July 1970 (8/30/70 Revision of 7/12/70 Vers.)	100-F-7	title-0	I/1-2	1-2
	Vol. I, No. 3-4, Aug-Sept 1970 (10/4/70)	100-F-8	title-0	I/3-4	1-2
	Vol. I, No. 4-X, Oct 1970(10/25/70) (prospectus issue)	99-F-9	1-4	I/4-X	1-4
	Vol. I, No. 5-6, Nov-Dec 1970 (3/28/71) Title p. & acknowledgements	98-F-10	title-2	I/5-6	1-2
	Editorial Notes, Letters to the Ed.	99-F-10	5-10	I/5-6	3-5A, 5B-6
	Vol. I, No. 7-8, Jan-Feb 1971 (7/4/71) Title p., ackn., copyright	98-F-11	title-4	I/7-8	1-2
	Editorial notes	99-F-11	11-12	I/7-8	3-4
	Vol. I, No. 9, March 1971(8/22/71)	97-F-12	title-2Z	I/9	1-2
	Editorial notes, letters, questions	99-F-12	13-14	I/9	3-4
	Vol. I, No. 10-11, Apr-May 1971 (9/5/ 71) Title p., list of figs.	99-F-13	title-2Y	I/10-11	1-2
	Vol. I, No. 12, June 1971(3/5/72) .	97-F-14	title-2X	I/12	1-2
	Editorial notes	99-F-14	15-16	I/12	3-4
	Vol. II, No. 1, July-Aug-Sept 1971 (6/8/72) Title & Table of three eras	97-F-15	title-2W	II/1	1-2
	Editorial notes	99-F-15	17-18	II/1	3-4
	Vol. II, No. 2, Oct-Nov-Dec 1971 (7/16/72)Title	97-F-16	title-2V	II/2	1-2
	Editorial notes	99-F-16	19-20	II/2	3-4
	Vol. II, No. 3, Jan-Feb-Mar 1972 (1/1/73) Title	097-F-17	title-4	II/3	1-2
	Editorial Notes			II/3	3-4
	Vol. II, No. 4, Apr-May-June 1972 (3/18/73) Title	397-F-18	title-44	II/4	1-2
	Editorial Notes	397-F-18	45-48	II/4	3-6
	Vol. II, No. 5, July-Aug-Sept 1972 . (6/24/73) Title	397-F-19	title-50	II/5	1-2
	Editorial Notes	397-F-19	51-54	II/5	3-6
	Vol. II, No. 6-A, Oct-Nov-Dec 1972 (9/16/73)	397-F-20	title-56	II/6A	1-2
	Editorial Notes	397-F-20	57-58	II/6A	3-4
	Vol. II, No. 6-B, Oct-Nov-Dec 1972 (9/16/73)	400-F-20		II/6B Wrapper & Contents List	

CTCM II/6A p. 22 is blank

The basic objective of the magazine, COMMUNICATION THEORY in the CAUSE of MAN, and the incomplete book formed from chapters from back issues of the magazine, is to bring useful concepts from communication theory to the citizen for use in helping build social institutions which are more democratic or at least do a better job of serving the interests of the people. To explain this approach, it is necessary to establish a reference chart of the hierarchies of systems in nature. Figure 1 is a first attempt to integrate the table in CTCM Section 3.3.0(1) with the table proposed by the interdisciplinary biologist, Dr. L. Raphael Troncale.(2)

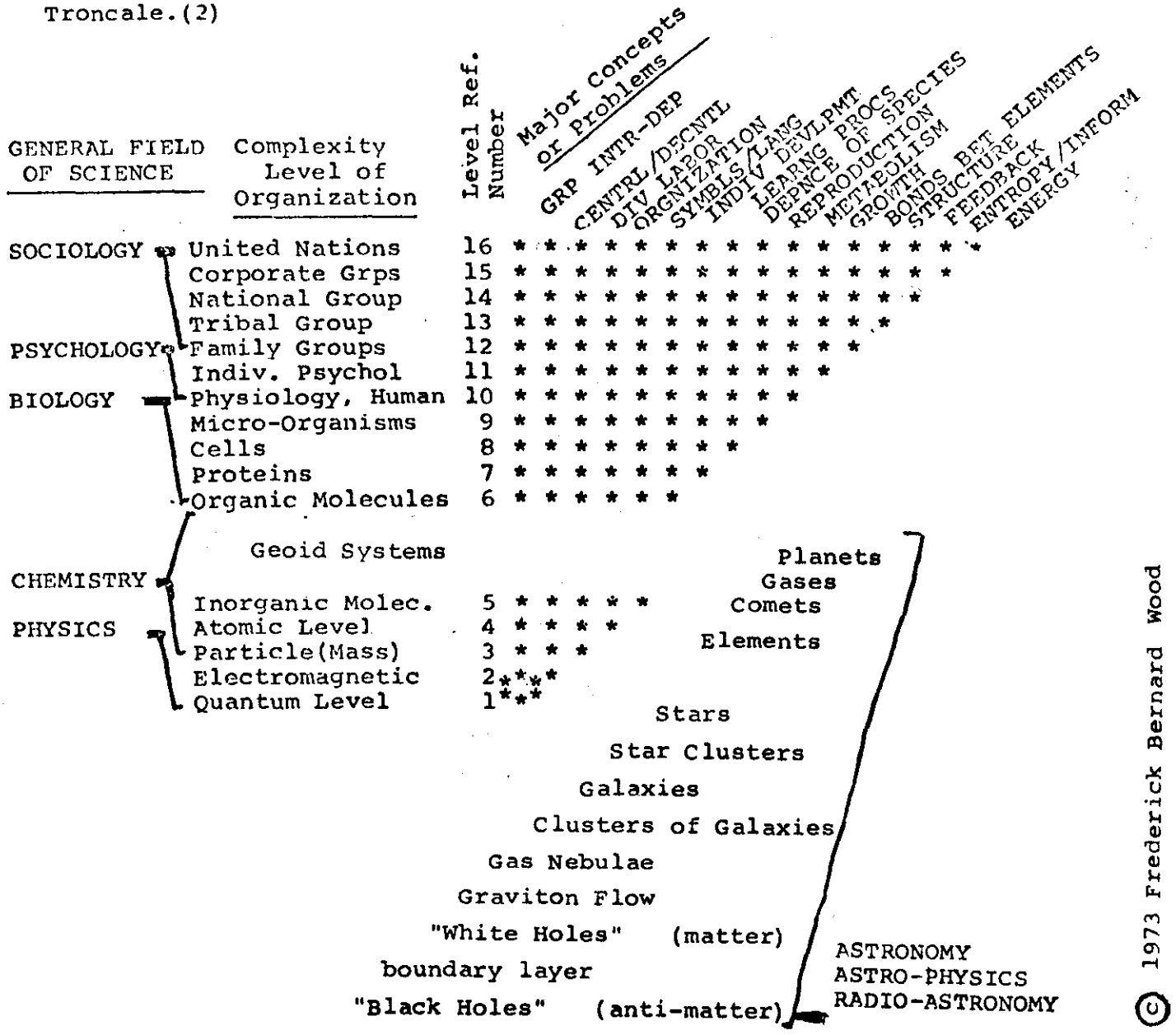


Figure 1 - Table of Hierarchies in Nature (A First Approximation)

Next the content of Fig. 1 is used as a reference background in Fig. 2 for overlaying the domains of seven candidates for general systems theory. Item #1 is the "maximizing of negentropy of social systems." This is shown in Fig. 2 as connecting the concept of entropy in physics and chemistry with entropy-like properties on the levels of human psychology and sociology. This in not really proposed as a general systems theory, but as an interim short-cut application of communication theory to use for the protection of democratic institutions until a more rigorous and generalized theory is defined and tested.

Item #3 is Haskell's "Unified Science," which covers more of the levels in the hierarchy of systems, but is not known to have been tested against an equivalent "completeness theorem."(3) Troncàle's set of axioms in item #2 provide the embryonic base for a more comprehensive general systems theory. Dr. Miller's item #4 is shown in four parts, representing the levels of living systems for cells, organs, groups, and organizations. (4) In Dr. Miller's work there are cross-level correlations that are not shown in Fig. 2 due to the space limitations for this first approximation chart.

Item #5 is Lamb's approach to analysing the potential for social change in terms of chemical thermodynamics.(5) The levels involved are similar to those of item #1. The principal difference in approach between #1 and #5 is that #1 is based on information theory, while #5 is based more directly on thermodynamics. Item #6 is Dr. Dodd's "epicosm model" for generating the major physical constants at jumps between the major hierarchial levels in the universe. So far there is no verified sigificance in repsect to any real problems. However the epicosm models do predict the number of planets in the universe capable of supporting life, but we have no known way to test the prediction.

Item #7 is Bergson's model of physical and biological evolution which extends to human societies. A limited number of parameters are included, but they are highly significant for the understanding of the evolution and stability of systems.

An important step was made toward integrating the insights of these different types of systems theories at the Far Western Regional Meeting of the Society for General Systems Research, September 13-15, 1973, Long Beach, California. While this integration work continues, I shall continue this interim approach of applying concepts from electrical communication theory to sociological problems. Eventually it may be possible to absorb these applications into a more generalized theoretical scheme.

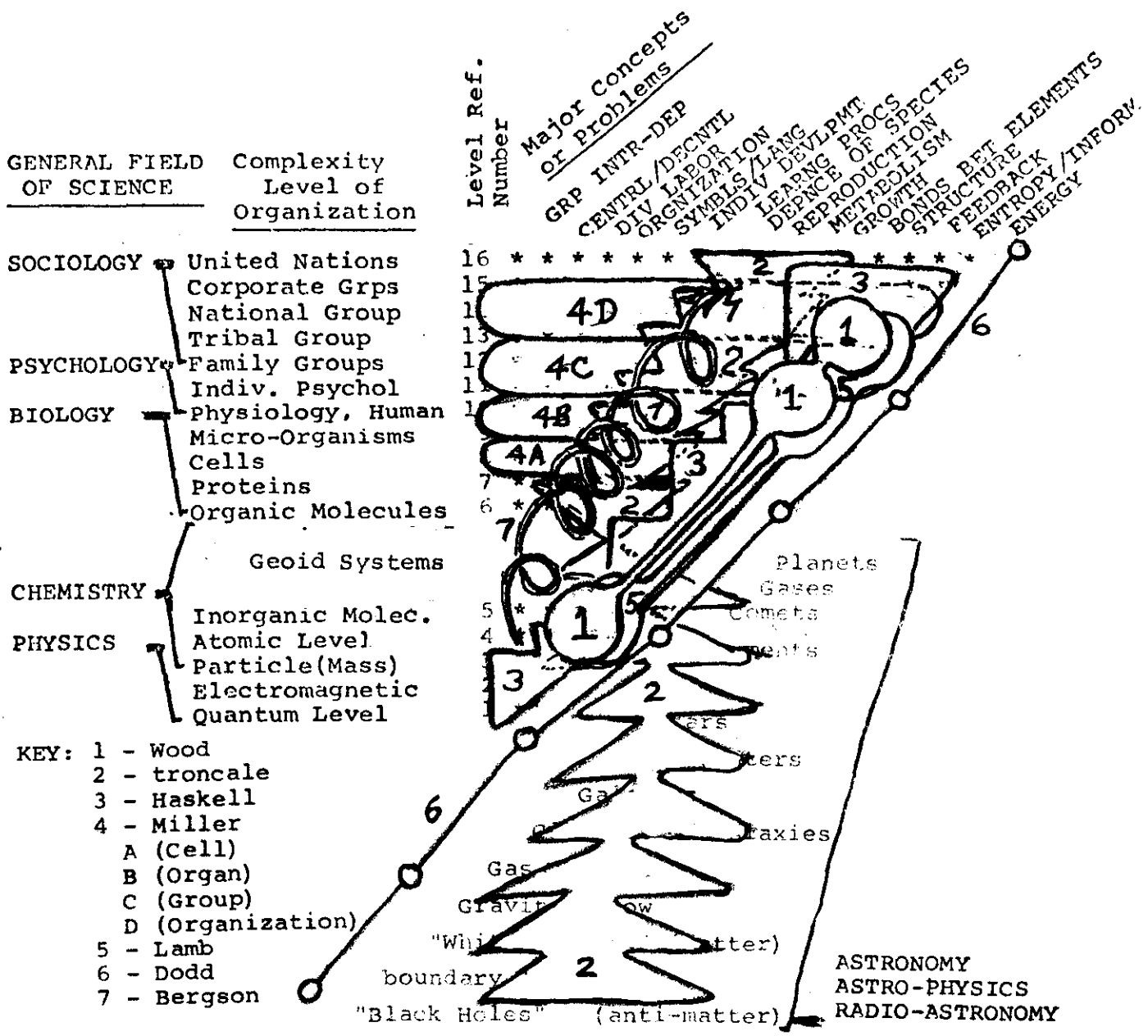


Figure 2 - Relationships between a Number of Candidates for General Systems Theories.

1. Frederick Bernard Wood, "Section 3.3.0: Status of Entropy, Information and Related Concepts in the Physical, Biological and Social Sciences." CTCM, Vol. I, No. 1-2, pp. 27-28. Reprinted in SEPR No. 401, "Entropy and Entropy-Like Properties of Different Levels of Systems, Their Usefulness and Limitations." (Second Annual Institute of Systems Education, California State University, San Jose, September 9-10, 1971) Reprinted in the book, COMMUNICATION THEORY in the CAUSE of MAN, P.O. Box 5095, San Jose, Calif., September 1973.

2. L. Raphael Troncale, "Origin of Hierarchies by the Action of Systems Field Axioms." Institute for Multidisciplinary Programs, California State Polytechnic University, Pomona, California 91768 (First Annual Western Regional Meeting of the Society for General Systems Research, Portland, Oregon, September 1972.) see pp. 11-13

3. Edward Haskell, editor, Full Circle, The Moral Force of Unified Science, N.Y.: Gordon and Breach(1972). See time graph of the system-hierarchy, p. 29, and definition of geoid, p. 228.

4. James G. Miller, "Living Systems: Basic Concepts" Chapter 3 in Gray, Duhl, and Rizzo, editors, General Systems Theory and Psychiatry, Boston: Little, Brown and Co.(1969). Based upon article in Behavioral Science, Vol. 10, pp. 193-237,(1965).
Related articles by James G. Miller are:
"Living Systems: Structure and Process", Behav. Sci., 10, p. 337-(1965);
"Living Systems: Cross-Level Hypotheses", Behav. Sci., 10, p. 411-(1965);
"The Nature of Living Systems", Behav. Sci., 16, 277-301(1971):
"Living Systems: The Organization", Behav. Sci.,17, p. 1- (1972);
"Living Systems. II. The Cell", Currents in Modern Biology, 4, p. 78-;
"Living Systems. III. The Organ", Curr.in Modern Biology,4, pp. 207-254(1971);
"Living Systems: The Group", Behav. Sci., 16, pp. 302-398(1971).
(For reprints of chapters and information on further parts of this series, write to Dr. James G. Miller, University of Louiville, Louisville, Kentucky 40201)

5. George G. Lamb, "Engineering Concepts and the Behavioral Sciences." General Systems, Vol. XIII, 1968, pp. 165-169.
"Basic Concepts in Subjective Information Theory, Thermodynamics, and Cybernetics of Open Adaptive Societal Systems." Record of the IEEE Systems Science and Cybernetics Conference, October 1969, Philadelphia, Pa., pp. 43-52.
"OAELIS: An Open Adaptive Evolutionary Learning Innovative Systems Approach." (Second Annual Institute of Systems Education, California State University, San Jose, Calif., September 1971)
(For further developments, write to Dr. George G. Lamb, Dept. of Chemical Engineering, Northwestern University, Evanston, Illinois 60201)

6. Stuart C. Dodd, "The epicosm model of the material and mental universes," Transactions of the International Congress of Cybernetics, Vol. III, Social Sciences, Chap. VII-19, pp. 1351-1365, plus exhibit D, c/o J. Rose, Blackburn College of Technology, Blackburn BB2 ILH, Lancastershire, England. (For reprints and recent developments write to Dr. S.C. Dodd, Sociology Dept., University of Washington, Seattle, Washington98105)

7. Bryan P. Bergson, "The Theory of Socio-Metabolic Transition," Pamphlet, 4pp., September 21, 1969, 15000 Jeanette Lane, San Jose, Calif. 95127.
"The Combination-Separation Principle," Conference Paper, 37pp., S.G.S.R. Western Regional Conference, Portland, Oregon, September 1972.

The following sections are derived from a paper presented April 26, 1966, at the Open Forum Session of the National Meeting of the American Humanist Association, Asilomar, California:

1.2.8: Equilibrium Between Order and Diversity as a Factor in the Development of Democratic Institutions.

2.3.4B: Technical Application of Balance Between Order and Diversity.

3.2.2A: Mathematical Probability Curves Used in Analyzing Order and Diversity.

The relationship between this application of Communication Theory to social problems and the more general formulation of General Systems Theory is discussed in:

1.0.9: Relationship of Application of Communication Theory to the larger field of General Systems Theory.

Statistically it is observed that a diversity of personality types occur in each generation of human beings. Throughout most of history the small fraction of a percent of people -- who were non-conformists were usually eliminated by society. On rare occasions a non-conformists would survive the brutalities of the force*era to give mankind a new concept or invention. It has been pointed out by Rashevsky(1) that in areas where there was more access to transportation large cities developed as the population of the cities permitted the non-conformists to join forces for protection.

The rise of fascism in Germany and Italy between World War I and World War II represented a new attempt by society to apply the new technology of the power*age to eliminate the non-conformists from society. Also Joseph Stalin's concept of "revolution from above" coupled with a conspiracy of the capitalist powers to inhibit the development of the first socialist super state, led to reactions in the U.S.S.R. which restrained non-conformists. Also the administrative procedures in some of the most enlightened capitalist organizations have tended to eliminate the influence of non-conformists in our society.

* The "force era", "power era", and "communication era" are discussed in more detail in Section 1.2.1(CTCM I/1-2), Section 1.6.2(CTCM I/10-11), and Section 2.1.2(CTCM I/7-8). These transitions are also discussed by Anatol Rapoport(4).

The development of electronic information processing techniques used in radar, sonar, and related bombsight techniques tipped the balance in World War II in favor of the democratically oriented nations. This victory in favor of democracy signalled the entry of the human race into a new era -- the information or communication era. Marshall McLuhan proclaims it as the electronic age.(2) If this is truly a new era, we should expect the mathematics of communication theory to show us the form of significant features of the social structure that would be viable in this new era. The mathematics of Information Theory and Cybernetics should give us the insights necessary to perceive abstract models of sociological development which could help us direct our political, economic, and social activities toward maintaining the proper balance between order and diversity to maximize the growth of democratic institutions.

When we examine one electrical communication theory model known as the continuous channel (an abstraction of a telegraph cable) we find that, if we substitute the probability of finding people and resources related to different political views for the probability of different signal voltages occuring on a telegraph line, and then use the mathematical formula for maximizing the transmission of information over the telegraph line as an operator on the probability distribution of political views tolerated in a given country, we find that by analogy we have a measure of what might be called "dynamic-justice" -- a measure of how well the country maintains a balance between order and diversity.(*)

It turns out that this mathematics predicts that for low levels of economic development that a high level of order with small tolerance for diversity is stable and that as the economic level rises, as measured by the per capita electric power production, the optimum diversity of political ideas tolerated increases, leading to a more democratic system as the optimum changes for higher power levels. This evolution toward a more democratic society is not necessarily automatic. The people have to understand these processes in order to realize the potential for a more democratic society. This theory says we don't have to settle for the increasing conformity empirically extrapolated by Clark Kerr, Industrialism and Industrial Man,(3) but

* For a development of this concept, see discussions in Section 1.0.2 (CTCM II/2), Section 1.1.1(d) (CTCM I/5-6, II/1), Section 2.3.2C (CTCM I/3-4), Section 2.3.4 (CTCM II/2).

by use of analogies from electrical communication theory we can point the way to a more humanistic and democratic world.

Now if we take a look back in history, we find that from the end of the last glacial age up to about three hundred years ago most major social and political arguments were settled by force, i.e., by the political leader who could organize the largest number of soldiers, slaves, or workers. The usefulness of the slaves was enahnced by force multiplying devices such as the invention of the lever, wheel, and pulley.

Starting with the invention of the steam engine, the application of gunpowder in weapons, the development of other explosives, and the invention of electric motors and generators, a qualitative change occured in human society. The resolution of major conflicts was shifted to those who organized the most energy converters or power amplifiers. Society ceased to be dependent upon the force of numbers of soldiers or slaves, but became more dependent upon the technology of the invention of power amplifiers.

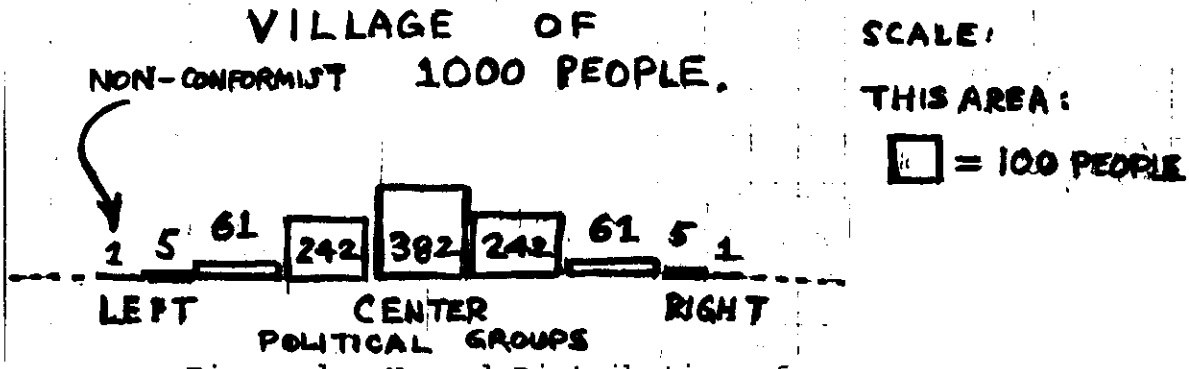


Figure 1 - Normal Distribution of People by Political Views.

Let us examine some features of this change. Back in the force era when most of the world's population was located in small villages, the normal distribution of people by political views might be as is shown in Fig. 1. The leaders of society in the process of organizing society normally liquidated the non-conformists who were the potential inventors. The social processes in the force era tended to cut off the tails of the distribution of types of individuals so that only those individuals conforming to the center portion of the distribution would survive as is illustrated in Fig. 2.

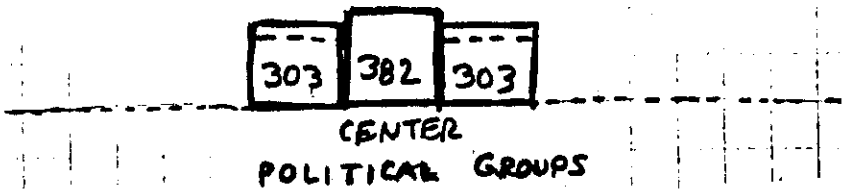


Figure 2 - Effect of Social Processes Liquidating Non-Conformists and Applying Pressures to Independents.

As more travel and communication developed between villages, and larger towns and cities developed, the same percentage of non-conformists meant more actual non-conformists were available in the larger towns and cities to get together and defend themselves. This is illustrated in Fig. 3. The higher probability of survival of non-conformists led to a faster development of science and technology.

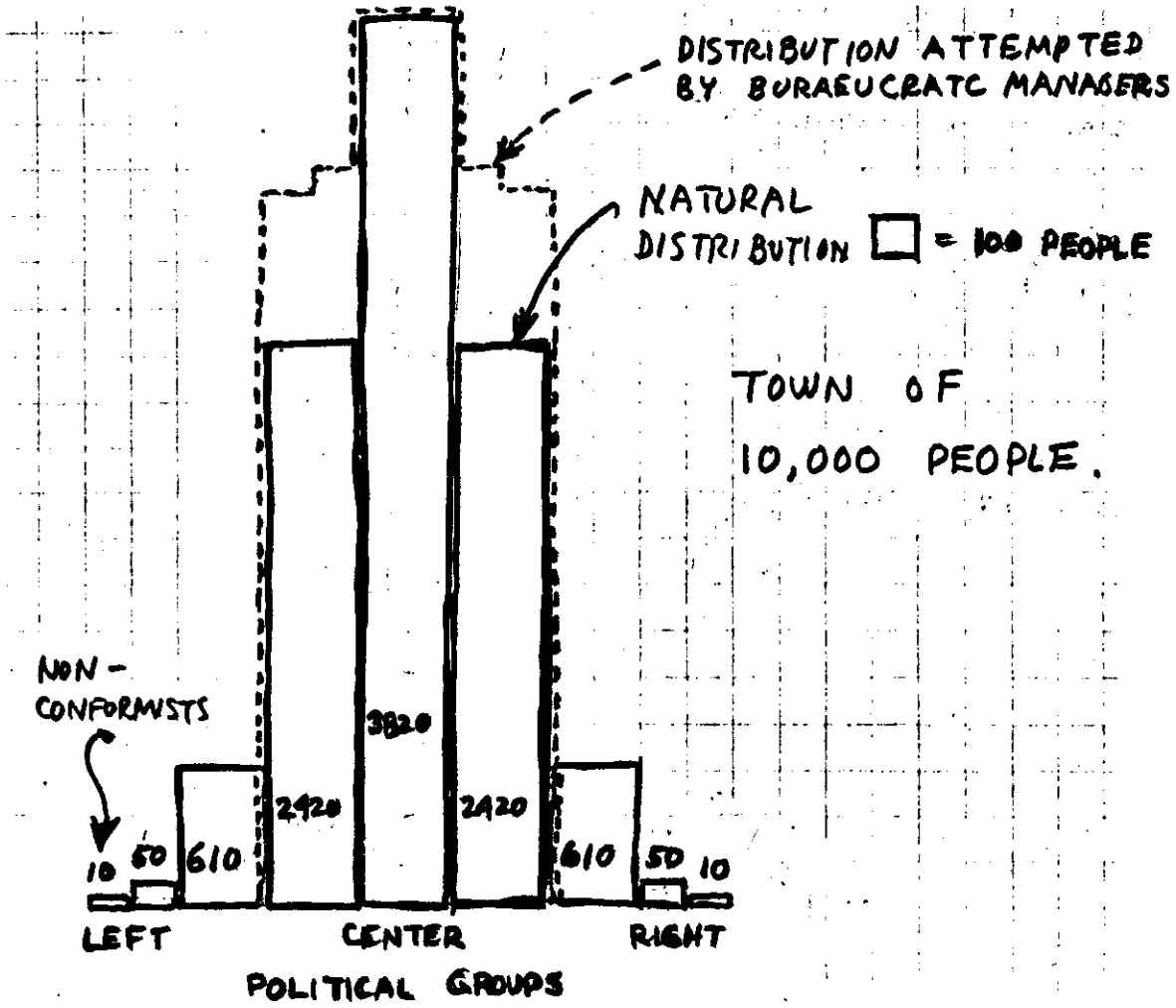


Fig. 3 - Distribution of People by Political Views in a Larger Population.

The dominant social organizations still derived from force era conditions where there was a scarcity of resources to fight over, utilized the new power amplifiers to generate more devasting wars. In the interim between World Wars I and II, the rise of fascism brought new applications of both the force era and power era techniques to bear on the destruction of human freedom. The democratically oriented

countries responded to the challenge of fascism by the organization of scientific research and development in the cause of democracy which resulted in the development of advanced radar systems in World War II. The development of advanced radar turned the balance on the Western Front of World War II in favor of the democracies. On the Eastern Fron the sieges of Stalingrad and of Leningrad ran into conditions where elements of an earlier era -- the force era became more dominant, when the supporting supply lines for the technology of the power era became too long. On the Western Front the development of radar enabled the British to track and shoot down the German V-1 rockets. The early introduction of experimental radar by the U.S.A. materially reduced the menace of the German submarines.

Now the victories for the more democratic countries of America and Europe came in 1943, 1944, and 1945 heralded the begginings of the "Communication Era." At the same time N. I. Vernadsky of the (5) Academy of Sciences of the U.S.S.R. perceived a transition into the "Nóosphere" in which he used ther terminology of Teilhard de Chardin to describe this new era we were entering. Three years after the end of World War II, the developments of the new "Communication Era" reached a more firm theoretical base. Claude Shannon published his articles on "The Mathematical Theory of Communication" in the Bell System Technical Journal (6) in 1948. In the same year Norbert Wiener published his book, Cybernetics or Control and Communication in the Animal and the Machine.(7) In particular, Norbert Wiener's analysis implied that the new developments in our understanding of the processing of information would have far reaching implications in all fields of the sciences, extending from physics and chemistry to biology to psychology and even to sociology.

After a rush of enthusiasm to apply cybernetics to everything, people lost interest in some of the broader scope of the developing Communication Era. However the wheels of progress spun on in the developing computer industry where the technological imperative of the electronics industry kindled a sustained growth of computer technology. The applications of concepts from the new Communication Era to sociology took a much longer time span. At a later date Norbert Wiener suggested that the broad application of new concepts takes approximately twenty years to accomplish on a sound basis.(8) Also

some of the earlier enthusiasts failed to utilize the available resources in the philosophy of science relative to how thematic hypotheses (9) in science are developed and tested.

Now after approximately twenty-five years of applying the concepts of Information Theory and Cybernetics to military weapons systems, we are on the threshold of applying these concepts to sociological systems for the benefit of the people. If we look at a telegraph line, radar system, or a set of computer insturctions and study the set of probabilities that different telegrams, radar signals, or computer instructions are sent or used, we find some interesting analogies for what Shannon calls the continuous channel model in electrical communication theory. For a given electrical power level in a communication system, Information Theory predicts an optimum probability distribution of signal voltages for maximum transmission of information. In Fig. 4 we have plotted some optimum distributions of signal voltages. However, we have labelled the scales with sociological parameters. The original waveforms with the electrical engineering scales are shown in Section 1.1.8.(*) and in Section 3.2.2A.

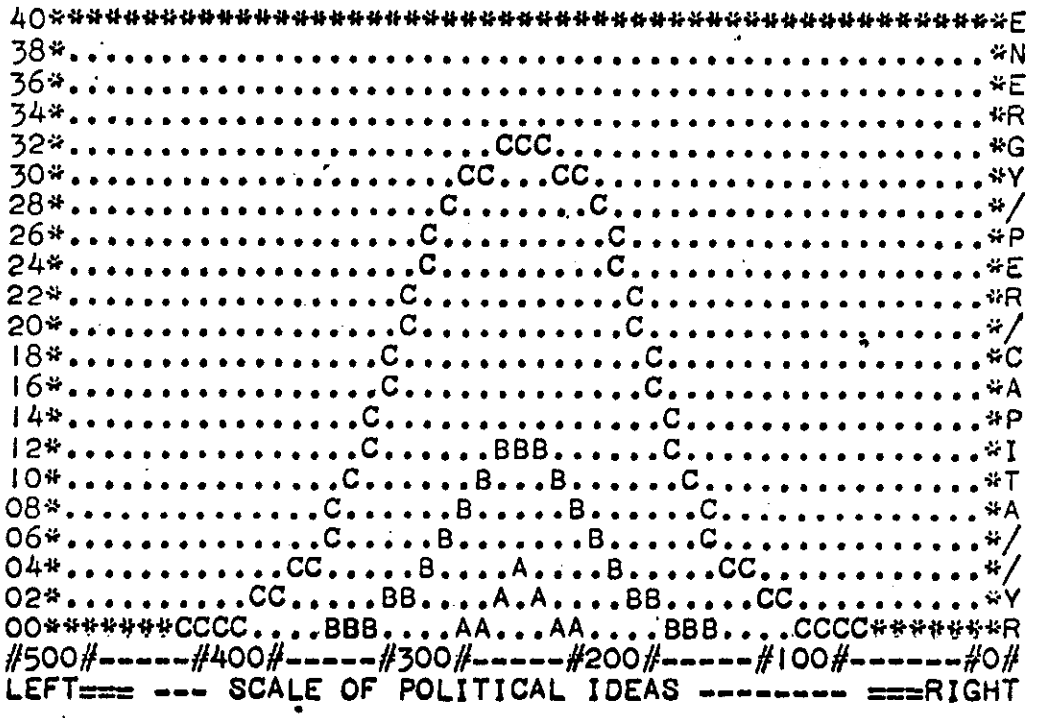


Fig. 4 - Ideal Distributions of Political Power in Social Systems based on Analogy from Voltage Distribution in Communications.

* For further details see Section 1.1.8(CTCM II/2).

Next let us look back at Figs. 1 and 3 on the distribution of people by political views in a social system before the non-conformists have been liquidated. If we were to smooth out the step-like curves in Figs. 1 and 3 they would look like the curves in Fig. 4. Now let us look at the significance of these curves in Fig. 4. These curves imply that for a country at the low level of 256 kwh/capita/year(curve A), it is optimum for this country 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/capita/year (curve B), it has to broaden its tolerance of diversity in political ideas in order to expand and maintain stability. As the energy production increases to 4096 kwh/capita/year (curve C) we note an even braoder spread of the bell-shaped curve. Exploring this set of curves indicates that the development of democracy in a country is dependent upon two critical factors relating to the distribution of power in the society. The first factor is the per capita power production in the country. The power production in the country must be above some critical value for the country to be able function well under democratic governmental procedures. The second factor is the distribution of power about the mean value. For democratic institutions to survive, we must push our institutions toward distributing power in accordance with the optimum curve for the stage of development of the country. Some sample curves are developed in Section 2.3.4B.

References:

1. Nicolas Rashevsky, formerly Committee on Mathematical Biology, University of Chicago, later at Mental Health Research Institute, University of Michigan, now deceased, wrote a number of papers on the conditions for non-conformists diffusing into the larger cities where they could organize for their own protection while participating in the development of new technologies.

N. Rashevsky, "Outline of a Mathematical Approach to History," Bulletin of Mathematical Biophysics, Vol. 15, 1953, pp. 197-235.

N. Rashevsky, "Some Quantitative Aspects of History," Bulletin of Mathematical Biophysics, Vol. 15,1953, pp. 339-359.

2. Marshall McLuhan, Understanding Media. N.Y.: McGraw-Hill(1964)

3. Clark Kerr et al, Industrialism and Industrial Man. Cambridge: Harvard University Press. (1960)

4. Adapted from A. Rapoport. "Mathematics and Cybernetics," Chap.87 in S. Arieti, editor, American Handbook of Psychiatry. N.Y.:Basic Books(1959), pp. 1743-1759, esp. p. 1747.

5. W. I. Vernadsky, Member of Academy of Sciences U.S.S.R., "The Biosphere and the Noosphere," American Scientist, vol. 33, no. 1, Jan. 1945, pp. 1-12.

6. Claude Shannon, The Mathematical Theory of Communication, reprinted with explanatory appendix by Warren Weaver, Urbana: Univ. of Ill. Press(1949)

7. Norbert Wiener, Cybernetics. N.Y.:Wiley(1948).

8. Norbert Wiener, "The Mathematics of Self-Organizing Systems.," pp. 1-21, Appendix III: On the Function of Science in Society, pp. 18-21, in Robert E. Machol and Paul Gray, Recent Developments in Information and Decision Processes. N.Y.: Macmillan(1962)

9. For information on "thematic hypotheses" see Gerald Holton, "On the Thematic Analysis of Science: The Case of Poincaré and Relativity," in Mélanges Alexandre Koyré, vol. II, Publication XIII in Histoire de la Pensée, Paris: Hermann (1964), pp. 257-268.

This section applies the concepts in more detail that were developed in Section 1.2.8. As an example we shall consider the estimated power distribution curves for Cuba, U.S.S.R., and the U.S.A. The numerical values used are not up to date, but are for years near 1965. Both the population and the estimated electric power distribution values are plotted in Fig. 1. The shapes of the curves in Fig. 1 are educated guesses as to the recent distribution of power as a function of a measure of political views. The measure of political views used hear is the "M.C.D." or "measure of collective direction." The approximate relationship to popular concepts of "anarchist", "capitalist", etc., is:

Concept:	Approx. M.C.D.:	Alternate Scale:
Anarchist	0	+ 200
Capitalist	100	+ 100
Co-Operative	200	0
Socialist	350	- 150
Communist	450	- 250

In this analysis the number of people per "M.C.D. Unit" is:

$$0.34 \times \text{population} / \sigma$$

where σ is the standard deviation for the ideal curve. The area under each curve in Fig. 1 is proportional to the total electric power production for that country. The population of each country is also shown in the figures for reference.

Ideal curves of electric power distribution plotted against an "M.C.D. Scale" of political views are shown in Fig. 2. For these three countries to become more democratic and help each other to become more democratic, they should work to come closer to their ideal curves. These countries can also work to change the ideal curves of other countries, by helping with economic aid that raises the per capita power production, and hence increasing the standard deviation of the corresponding ideal curve.

More details on the construction of these curves are given in Section 3.2.2A.

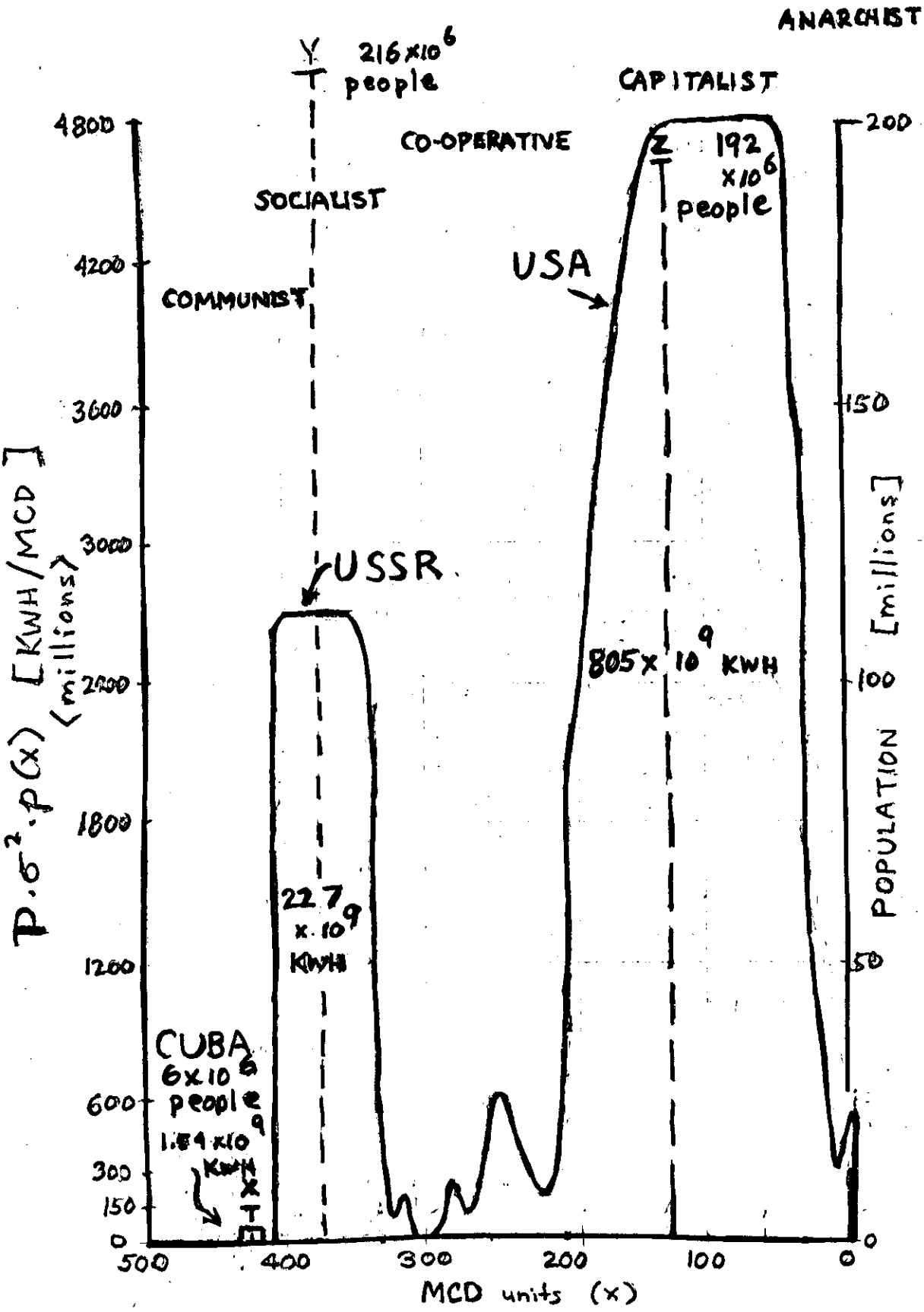


Fig. 1 - Estimated Distribution of Electric Power by Political Views in three countries and their population.

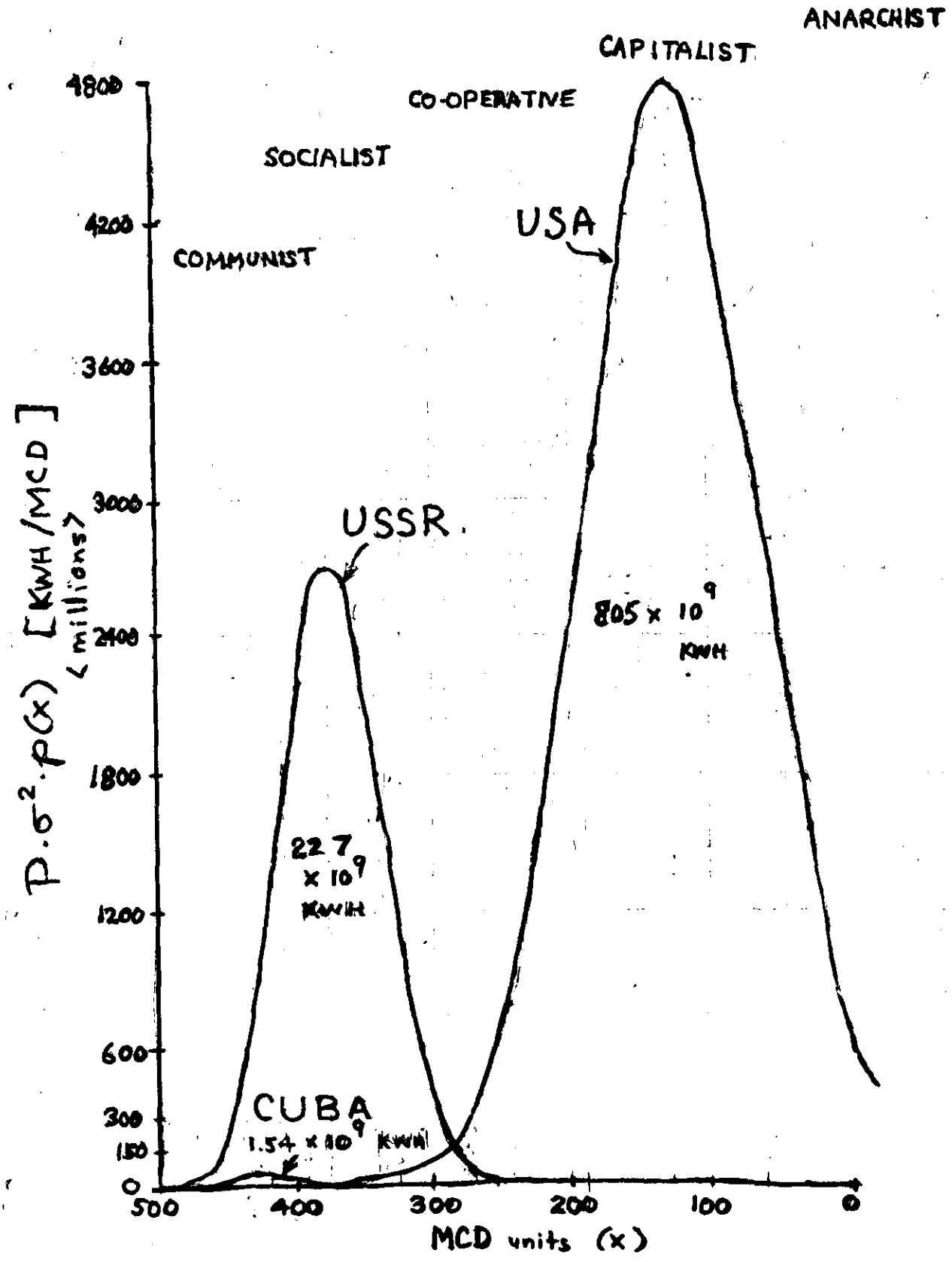


Fig. 2 - Ideal Electric Power Distribution by Political Views for Three Countries.

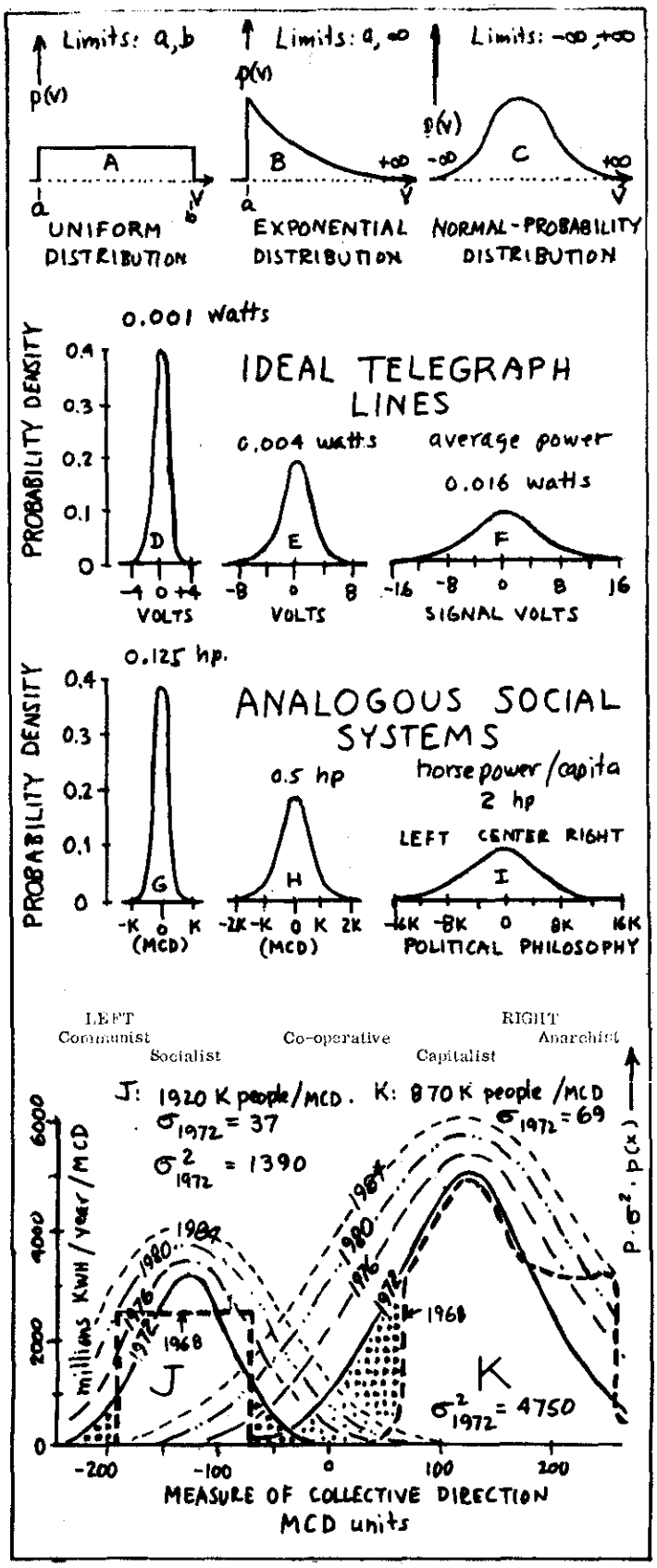


Fig. 1 - Alternative Boundary Conditions and Examples of the Analogy between Social Systems and Telegraph Lines.

Fig. 1 is repeated from Section 1.1.8* for reference in discussion of why the gaussian probability distribution is used in these examples. In Section 1.1.8 it was pointed out that Fig. 1-A appears to relate to the Force Era, Fig. 1-B to the Power Era, and Fig. 1-C to the Communication Era.

* CTCM II/2(File 118)

An alternative procedure is to determine the boundary conditions relevant to the range of political views and from them determine whether curve 'A', 'B', or 'C' of Fig. 1 is applicable.

If there are fixed limits on the left and right for the possible range of political views that people can develop, the curve of Fig. 1-A would be applicable. However it appears more plausible to consider political views or philosophy as having a potential range from minus infinity to plus infinity. Therefor we use gaussian curve of Fig. 1-C for the case of a range of political views.

The probability density functions for the voltage distribution on an ideal telegraph line are shown for

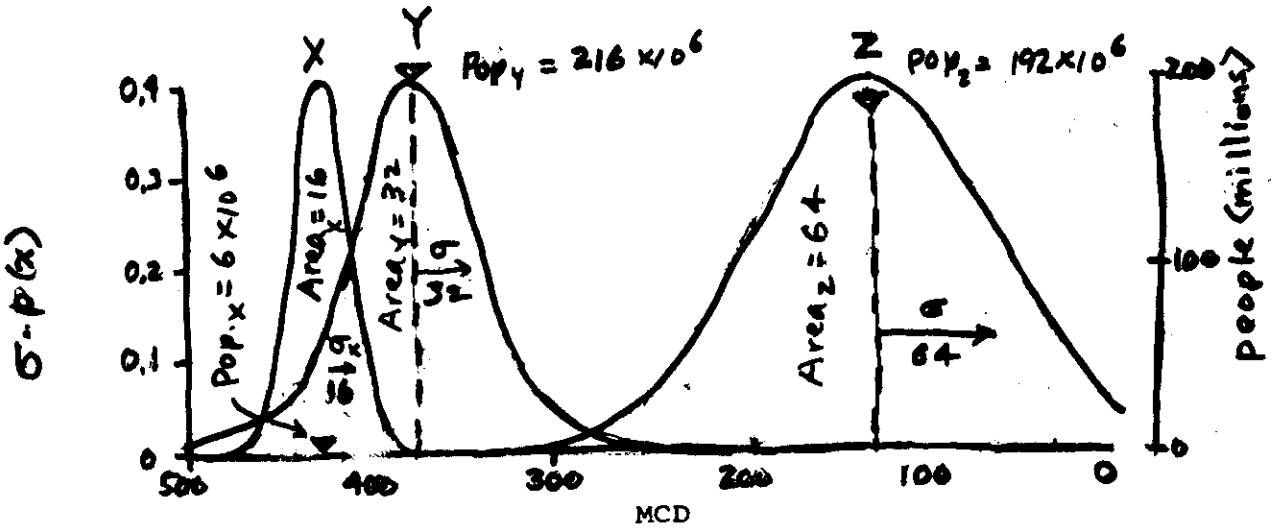
three power levels of 0.001, 0.004, and 0.016 watts in Figs. 1-D, -E, and -F. Similarly the ideal probability density functions for political philosophies are shown for three per capita power production levels of 0.125, 0.5, and 2.0 horsepower in Figs. 1-G, -H, & -I.

The procedure that I am using here is to first develop a "thematic hypothesis" in the sense described by the physicist and philosopher of science, Gerald Holton, in the chapter, "The Thematic Imagination in Science," in SCIENCE & CULTURE(Boston: Beacon Press, 1967). Second, I am making a number of sample analyses like this one in this issue of CTCM. Third, I am publishing a table for testing hypotheses similar to the type used by the physicist, Wolfgang K. H. Panofsky, for showing how scientists test the validity of the special theory of relativity in the book, CLASSICAL ELECTRICITY AND MAGNETISM(Reading, Mass: Addison-Wesley, 1962). Fourth, I am inviting scientists to point out any defects that I may have overlooked. In connection with this testing, I am reserving up to one-third of the space in the magazine, COMMUNICATION THEORY in the CAUSE of MAN, for letters to the editor, questions, and short articles from people who question, dispute, or have competing theories in respect to my approach.

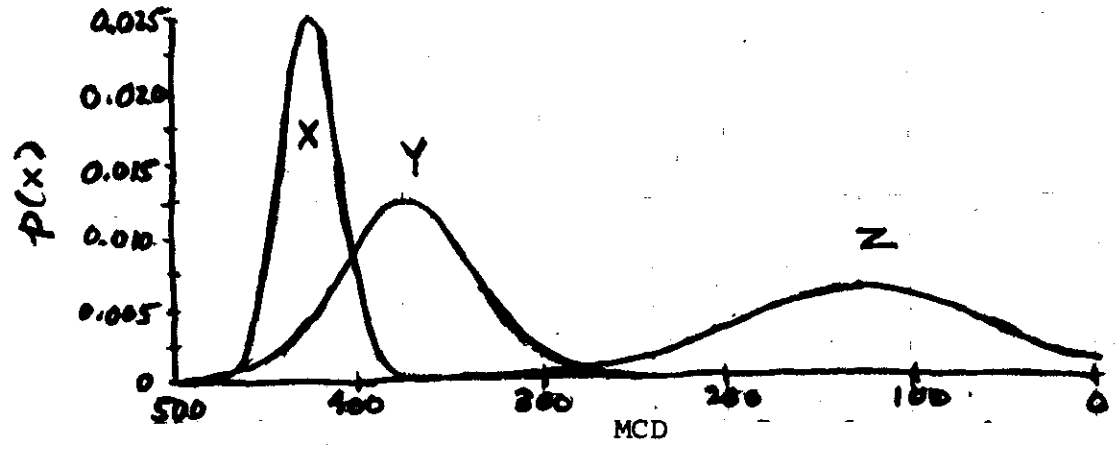
To return to the discussion of Fig. 1, I am referring the reader to Section 1.1.8* pp. 2-3, for the discussion of the sets of curves in Fig. 1-J & 1-K.

For reference in checking on how the curves in Fig. 2 in Section 2.3.4B(File No. 234-F-20, p. 11) were constructed, a set of generating curves are shown in Figs. 2(a), 2(b), and 2(c) of this section. The ideal curves in Section 2.3.4B, Fig. 2, were constructed by multiplying the population values (X,Y, & Z) if Fig. 2(a)/322/ by the σ^{-2}. p(x) curves in Fig. 2(c)/322/.

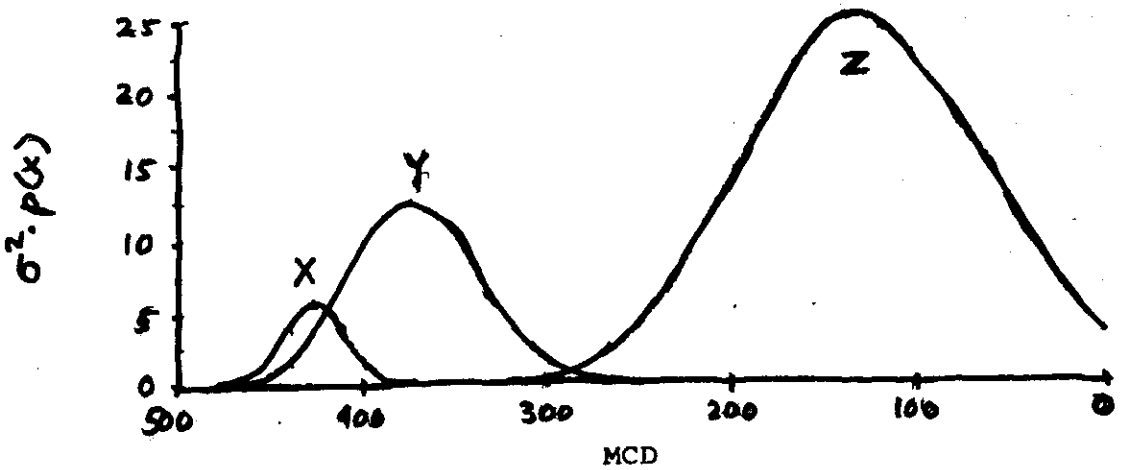
* Section 1.1.8 is in CTCM II/2, pp. 9-11. Refer to the September 1973 Book version of CTCM or order a copy of the reprint of CTCM II/2.



(a) Probability Density Generating Functions and Population.



(b) Ideal Political Idea Distribution Density.



(c) Ideal Per Capita Power Distribution.

Fig. 2 - Reference Curves for Construction of Ideal Curves of Countries X, Y, & Z (Cuba, U.S.S.R., & U.S.A.) in Section 2.3.4B.

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