VOL III NO 2

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.

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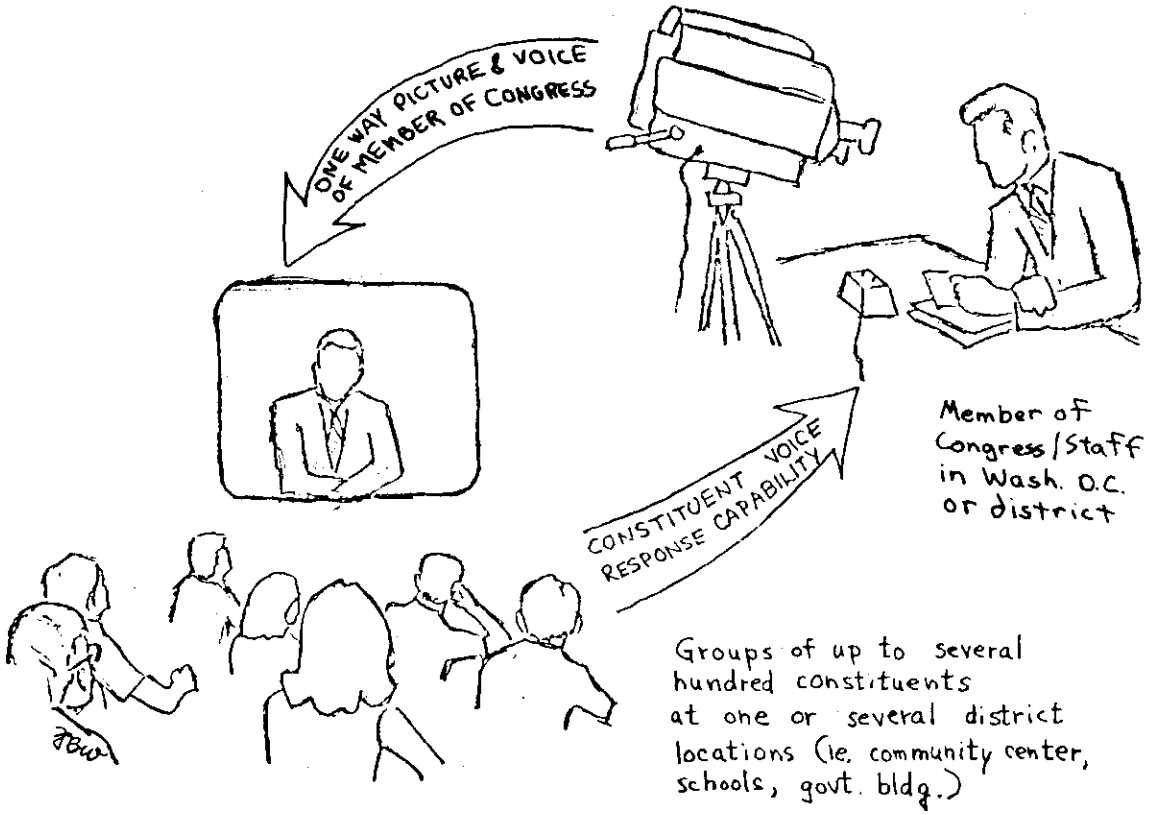
Politics on the Cable



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COMMUNICATION THEORY IN THE CAUSE OF MAN

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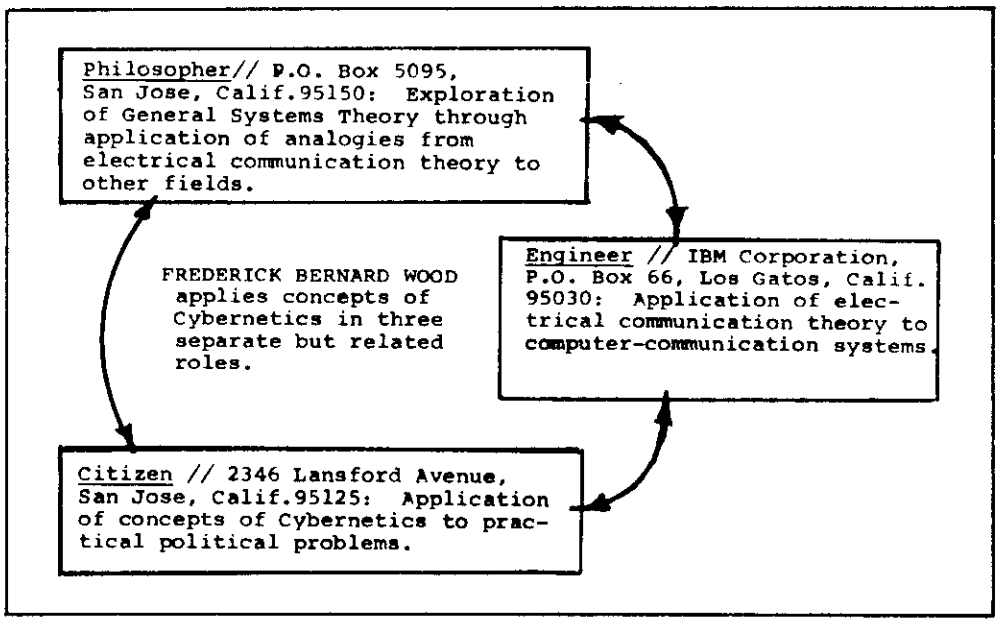
Section 3.9.7: Editorial Notes, Letters to the Editor, Notices

For a second time various problems have interrupted the publication schedule of this magazine for more than six months. When this occurred the first time, I sent a letter of explanation to paid subscribers (April 12, 1974). Then Volume III, Number 1, was published on 9/28/74 approximately twelve months after the last issue of Volume II. This time after a delay of eight months, a letter of explanation was prepared May 24, 1975, and mailed to paid subscribers with a preprint of my June 1975 paper on "Some Social Implications of the Mathematical Theory of Communication Channels," for the I.E.E.E. International Communications Conference in San Francisco.

With this second delay, it became apparent that some reorganization was necessary in order to continue publication. Therefore a plan has been developed to resume publication through a combination of obtaining some financial backing to pay for part time editorial assistance and some changes in my time allocation.

One factor that has compounded delays from various sources has been the conflict between interpretations of the code of ethics of the National Society of Professional Engineers requiring full identification of the potential business and financial interests of engineers speaking on public issues with the pressures from my employer to remove any clues indicating my connection with IBM. To clarify such questions I include the diagram below to indicate my three different roles as engineer, philosopher, and citizen:



The views presented in articles in the magazine, COMMUNICATION THEORY in the CAUSE of MAN, are my own views, or those of the particular authors, if signed, and represent neither the IBM Corp., nor any political or religious groups with which I or other authors are affiliated.

Frederick Bernard Wood
Frederick Bernard Wood
Editor and Publisher

CALL FOR PARTICIPATION: SYSTEMS THINKING AND MATERIALS INFORMATION SYSTEMS

Fred B. Wood

The George Washington University

AN OPPORTUNITY FOR SGSR INPUT

At the January 1975 SGSR National Meeting, many participants spoke of the potential of systems thinking for improving our quality of life. Here is an opportunity to help translate that potential into reality with regard to one important dimension of the quality of life: the management of our natural resources.

In response to congressional concern over possible future shortages of critical metals and other materials resources, the Congressional Office of Technology Assessment (OTA) has undertaken to sponsor an assessment of Materials Information Systems. The assessment is being conducted under contract by the IBM Corporation with the support of The George Washington University's Program of Policy Studies in Science and Technology.

Part of the Program of Policy Studies responsibility is to obtain relevant input from interested individuals and organizations, including public interest and professional groups such as SGSR. Therefore, Policy Studies is collaborating with SGSR and other groups to, first, establish an awareness of the assessment itself and, second, provide an opportunity for interested persons to make a useful contribution to the assessment.

INFORMATION AND MATERIALS MANAGEMENT

The problem of natural resources and materials shortages is clearly a systems problem, and, in the opinion of many, one key element to better management of our natural resources is an improved national materials information system. Our hope is that SGSR members who find this assessment of interest will communicate directly to the Project Manager at the address and phone number given at the end of this article.

This assessment will help OTA provide an analytical base for future congressional policy decisions on national materials management. In considering the information needs for materials management, the assessment will consider the full scope of natural resources, including fuels, which are utilized by industry for the production of goods. This ranges from inorganic metals and minerals to organic substances such as lumber and fibers. However, for the purposes of this study, food is not included in the definition of materials.

Information needs will be examined for all stages of the cycle of materials utilization, from initial acquisition of raw materials through the steps of processing and manufacture and use as products to the eventual disposal as waste and possible availability for re-use or recycling. At each stage, attention will be focused on the interrelationships between information on materials, energy, and the environment.

THE ASSESSMENT PROCESS

Participation of interested SGSR members will be particularly useful in several ways. First, interested SGSR members can choose to participate in an assessment survey (by interview and/or questionnaire) which focuses on (1) the social, economic, political, and other possible impacts (both positive and negative) of a national materials information system, (2) the key policy issues which may emerge from such impacts, (3) advantages and disadvantages of alternative institutional arrangements for the location and operation of a national materials information system, and (4) advantages and disadvantages of alternative actions for implementing the systems and institutional options.

Second, SGSR members with an in-depth information systems background may wish to critique the information systems options developed in the study. Those interested in this aspect will be provided with more detailed interim reports on the information systems concept. Third, SGSR members with a continuing and major interest in the materials area may wish to contribute to, or at the minimum critique, other phases of the assessment, including preparation of papers and reports for ultimate submission to IBM and OTA.

CONTACT THE PROJECT MANAGER

Interested SGSR members are encouraged to contact the Project Manager by mail or phone and indicate your desired level of participation. Address all inquiries to Dr. Fred B. Wood, Project Manager, Program of Policy Studies in Science and Technology, 714 University Library, The George Washington University, Washington D.C. 20052, Phone 202-676-7380. You may also suggest other individuals or organizations with a possible contribution to any phase of the study. We look forward to hearing from you soon.

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

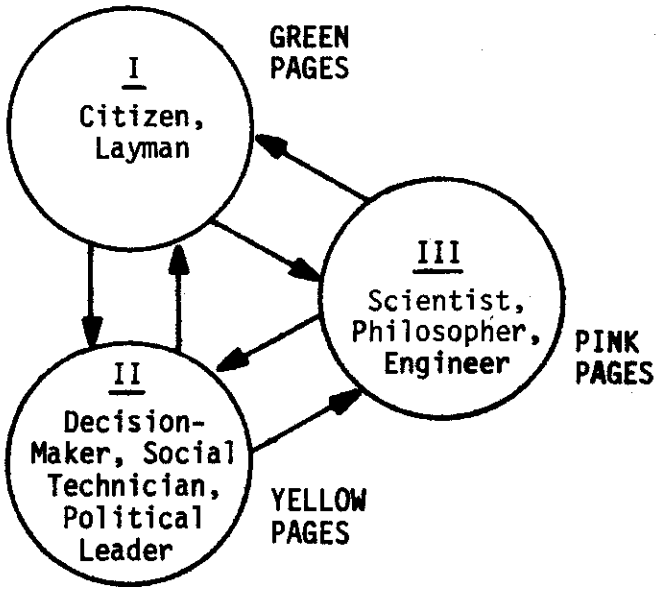
Magazine 'CTCM'	Book 'CTCM'

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

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

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

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



For the benefit of the new reader who has not followed the earlier issues, an abridged outline of the projected loose-leaf book is displayed below. For a more detailed outline and listing of which sections have been printed to date, see 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 Conecpts
- 2.2 Application of Cybernetic Technologies
- 2.3 Applications for Implementing 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

Section 1.6.8: Telecommunications Technology for Congress

In the summer of 1973 Frederick Bruce Wood, while a graduate student at The George Washington University, Washington, D.C., conducted an in-depth study of the prospects of new telecommunications technologies helping the congressional-constituent relationship. The potential uses of teleconferencing, cable television, videoconferencing, and videophone are illustrated in the sketches on the next two pages. In addition his studies included a survey of the views of a cross-section of members of congress on the present and future uses of conventional communication processes such as face-to-face channels, written or printed channels, news media channels, individual telecommunication channels, and mass telecommunication channels.

The complete report of his studies are contained in his thesis:

"Telecommunication Technology for Congress: An Exploratory Assessment of Its Potential for Congressional-Constituent Communication," by Frederick Bruce Wood, May 1974, The George Washington University, Washington, D.C., 374 pp. Copies can be order from University Microfilms, Ann Arbor, Michigan.

A shorter summary of his studies is available through the National Technical Information Service:

"The Potential for Congressional Use of Emergent Telecommunications: an Exploratory Assessment," by Fred B. Wood, May 1974, Program of Policy Studies in Science and Technology, The George Washington University, Washington, D.C. Monograph No. 20, 60 pp.

Abstract The author summarizes the results of an exploratory inquiry into the potential use of emergent telecommunications technology for communication between congressmen and their constituents. The study employed a number of specific methodologies: interdisciplinary systems model-building, technology analysis, a sample survey, and semi-structured interviews using sketches of the emergent channels.

Six telecommunication configurations were identified as representative of emergent channel characteristics: the teleconference, videoconference, videophone, cable television, cable TV polling, and information retrieval. Analysis of the interview data resulted in an overview of the current congressional-constituent communication system and an assessment of the potential for emergent telecommunications, as perceived by congressmen and senior staff from the 40 offices in the stratified judgment sample.*

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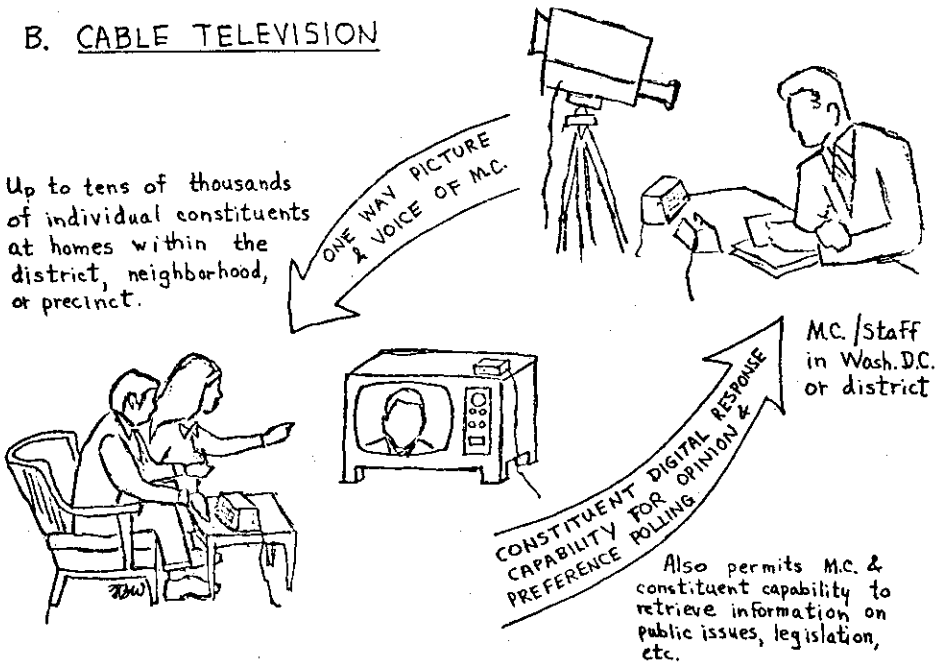
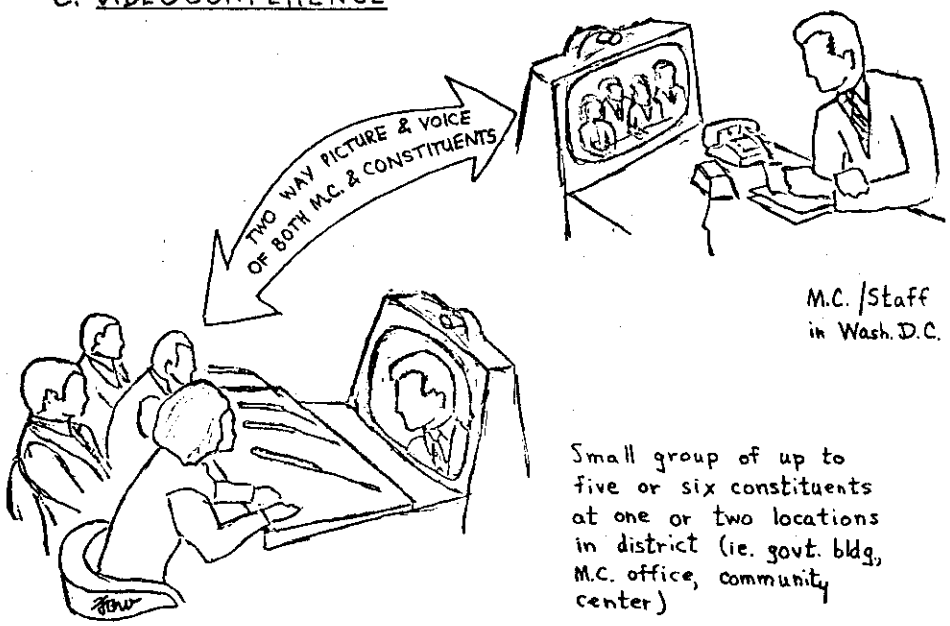
*See Section 2.6.2 of this issue of CTCM for an extension of these studies to the use of cybernetic (or information theoretic) principles to obtain an equitable allocation of cable origination program time among a group of political candidates.

FUTURE CONGRESSIONAL-CONSTITUENT TELECOMMUNICATION:

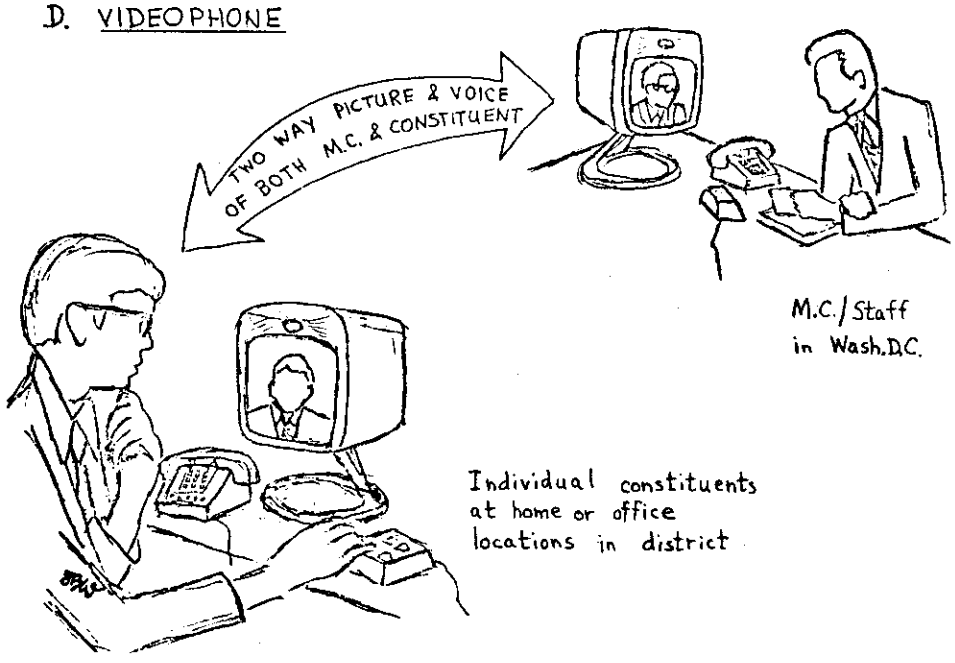
Four Sketches of Potential Telecommunication Links
Between Constituents and Member of Congress (M.C.)



C. VIDEOCONFERENCE



D. VIDEOPHONE



Biographical Sketch

Fred B. Wood* was born in Cambridge, Massachusetts, on September 18, 1945; grew up and attended public schools in Berkeley and San Jose, California; and received his college education at Oregon State University (B.S. in electrical engineering, 1967), Harvard University (M.B.A. in business administration, 1969), and The George Washington University (D.B.A. in management systems and public administration, 1974), where he completed his dissertation research on "Telecommunications Technology for Congress: An Exploratory Assessment of Its Potential for Congressional-Constituent Communication."

Dr. Wood's professional experience has included short stints with the County Government of Santa Clara, Calif. (Sr. Engineering Trainee), Pacific Gas and Electric Co., San Francisco (Junior Engineer), and International Business Machines Corp., Armonk, N.Y. (Public Affairs Researcher); and a one-year term as Editor and Publisher of The HarBus News and Careers and the MBA at Harvard Business School, Boston.

At The George Washington University, Dr. Wood has served as Graduate Teaching Fellow in Management Science, Assistant Professorial Lecturer of Management Systems, Guest Lecturer on Congressional Information Systems, Research Assistant and Research Associate in the Program of Policy Studies in Science and Technology, where he is currently a Research Scientist. Dr. Wood has authored several articles, is a member of the IEEE, SGSR, APSA, AAAS, and WFS, and has published a monograph on The Potential for Congressional Use of Emergent Telecommunications: An Exploratory Assessment. For details, contact Dr. Wood at the Program of Policy Studies, 714 University Library, The George Washington University, Washington, D.C. 20052.

*Fred B(ruce) Wood

SECTION 2.6.2: POLITICS ON THE CABLE: A CYBERNETIC APPROACH TO ACCESS ALLOCATION*

by

Fred B. Wood
The George Washington University

The issue of access of political candidates to the mass electronic media is symptomatic of the transition of American society through the so-called Second Industrial Revolution into the "Post-Industrial State" or "Communication Era," a time when the major new tools of society are information amplifying devices.[1]

Mass media, and broadcast television in particular, have become an essential part of the modern day political campaign, especially at the congressional level and above.[2] But the technical and economic limitations of broadcast TV mean that only a few channels are available at very high cost in most media markets.

In order to attempt to protect the public interest, the Federal Communications Commission (FCC) established the "equal time" rule, which requires that TV stations afford equal broadcasting opportunity to all candidates for any particular public office. That is, the same amount of commercial time must be made available at the same price (or free, if public service time) to all candidates for the same office.[3]

Unfortunately, the net effect of this rule appears to discriminate against political communication in general and especially candidates from major media markets and/or those with limited campaign funds. First, most broadcast stations end up providing very little time, due in large part to their concern about having to provide equal opportunities to third party and minor party candidates. Second, in major markets (like New York,

Los Angeles, Boston, San Francisco-Oakland-San Jose, and Washington D.C.), stations are reluctant to provide time also because most political contests relate to only a small part of the media market and total viewing audience.[4]

Many stations apparently believe that political programming costs them money directly, if on a public service basis (by pre-empting revenue producing shows), and/or indirectly, if on a paid basis (through reduced audience ratings leading to lower advertising rates). The general result is to limit the total political dialogue on television, with a specific media advantage accruing to incumbents or challengers with personal affluence or special interest financing who are better able to raise funds for paid television time.

The purpose of this paper is to explore the potential of some of the information amplifying devices of the Communication Era for solving these problems of political access. Specifically considered are cable television--a physical tool or "hard" technology of communication--and cybernetics-- an intellectual or "soft" technology of communication. These tools are applied here in the context of congressional politics, but the relevance for local politics is perhaps even greater.

Cable Television: The Technology of Abundance

The use of cable for television reception began more than two decades ago with community antenna cable television (CATV) in parts of the country where terrain or distance precluded direct over-the-air broadcast reception. The traditional CATV system employs a tall antenna to pick up distant TV signals which are then relayed and distributed by coaxial cable to individual homes in nearby communities.

Such CATV systems thus simply serve to extend the reach of broadcast television into typically remote or mountainous areas. These systems are

small and of limited channel capacity (about 6 channels on the average). At most, the only extras provided are automatic local origination of time, weather, or news and stock ticker information on otherwise unused channels. This first generation CATV still accounts for perhaps three-quarters of all cable systems but only about one-third of total cable subscribers.[5]

During the 1960s, the second generation of cable came into its own. Unlike the earlier CATV, most recent growth of cable television has been in more populated and urbanized areas, and no longer depends solely on a community antenna for signal reception

In order to attract subscribers in the larger media markets, cable generally provides additional services besides improved reception quality. The most important of these extras are distant signal importation (of network, independent, educational, sports, or special feature programs from other media markets) and non-automatic local origination (live, videotape, or film) offered over a larger number of channels (twelve or more). About 20-25% of all cable systems now provide such a service package.[6]

And it is at this point of evolution that cable really becomes a new telecommunication medium. Due to the limited supply of electromagnetic spectrum in the frequency range most suitable for broadcast television, and the resultant scarcity of channels, cable provides a potentially viable alternative. By transmitting television signals through a coaxial cable rather than over-the-air, as many as twelve, twenty-four, or more channels of programming can be carried simultaneously (over a broad range of frequencies without interference) at low cost to the subscriber (about $5-6/month).

Thus the key to cable's rapid growth since 1964, averaging 20-25% annually with over seven million current subscribers (about 10-11% of all television households in the country),[7] is the combination of: better

reception quality, distant signal importation, local origination, many more channels, and low cost. However, whereas in earlier years CATV was restricted to rural areas and minor television markets, cable now appears to pose a competitive threat in many major markets. As a result, the broadcasters, copyright owners, and federal government telecommunication agencies, among others, have moved vigorously to protect whatever they perceive to be their vital interests. The future growth of cable therefore may depend in large part on ultimate outcomes in the regulatory and political, as well as economic and technical, arenas of the United States.[8]

Following several years of intense controversy, in early 1972 the FCC promulgated a new set of cable regulations which appear to be designed to guide cable television development in the direction of a broadband communication system or network.[9]

The essence of the broadband communications concept is that, because of its potential abundance of channels, cable can and should do much more than simply passively carry existing boradcast signals. In addition, cable should provide a diversity of and access to programming and services which are otherwise not available.

Apparently, the intent of FCC regulatory action is in part to realize some of this long-term potential while as the same time hopefully giving cable a viable short-run economic base. Accordingly, the rules permit all cable systems to import some distant television signals (subject to important limitations) but require that systems in the 100 largest markets provide at least twenty channels and the following nonbroadcast services: local origination known as "cablecasting" (for systems with at least 3500 subscribers), leased channels, public access channel, educational channel, local government channel, and a capacity for two-way digital services. These rules

apply immediately to all new systems; existing systems were given up to five years to comply.[10]

So, while the cable future is still fraught with many problems and much uncertainty, cable technology does appear to offer potential relief from the technical and economic limitations of broadcast television. Hopefully, through the creative use of intellectual tools like cybernetics, we can learn how to apply cable to solve problems of political access to the media.

Cybernetics: The Science of Communication

Cybernetics is the interdisciplinary science of communication and control in both machine and living systems.[11] Articulated originally by Norbert Wiener, cybernetics (from the Greek "kybernetes" meaning steersman, or governor in English) is operational primarily at the level of machine and living systems which are amenable to mathematical formalization and manipulation (like electronic radar and human nervous systems) but clearly has potential application to higher level and less tractable social systems.[12]

Cybernetics is also the branch of general systems theory concerned with models, principles, and laws of communication and control which apply to machine or living systems in different scientific fields and at various levels of phenomena. In its broadest definition, cybernetics can be taken as the science of organized social complexity and focuses on (1) communication--for the exchange of information and transmission of meaning--as the very essence of social systems, (2) control--for the attainment of specified social goals through the use of feedback and feedforward loops--as a prerequisite of self-regulating social systems, and (3) the individual and institutional modes of perception and values which provide the basis for both meaning of communication and goals of control.[13]

Within the context of political communication at the congressional level, Figure One is a very simplified cybernetic model of such a self-regulating system. A complete model would of course have to include the executive and judicial branches of government with appropriate communication links, and perhaps should be further disaggregated to identify other specific communicating entities such a lobby groups, opinion polling organizations, media commentators, and peer groups.[14] In this simplified version, all components except those in the congressional-constituent communication process are lumped into the environmental block labeled "real world situation."

A typical conceptual application of the cybernetic model might proceed as follows. In the face of a real world characterized by increasing complexity and rates of change, cybernetic principles suggest that the social system or a subsystem thereof can cope with the environment only if it can match the variety or complexity of that environment.[15]

Put differently, if the congressional-constituent communication process is to remain viable, its internal variety must increase so as to match the increases in variety of the real world situation. This increase can be accomplished in part through changes in the dynamic structure of the social system, for example by the addition of new internal feedback loops and communication channels.[16]

If the net effect of such changes in internal structure is to improve the exchange of information and transmission of meaning both within the system and between the system and its environment, then the system will be better able to adapt to the changing real world anvironment. In a healthy system, positive and negative feedback processes should modify or reinforce system behavior so as to help insure the setting and attainment of goals which are consistent with system survival.

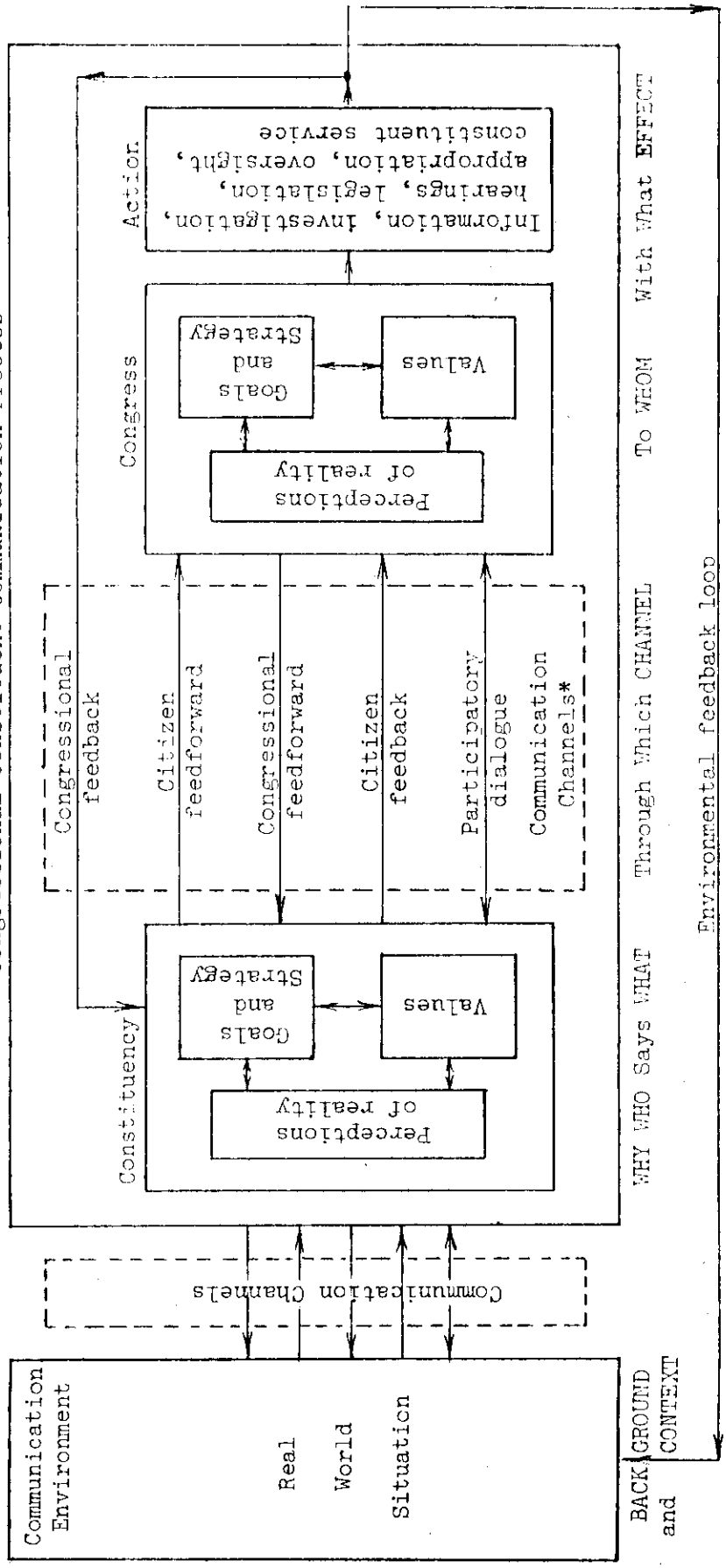


Figure One. Simplified Cybernetic Model of the Congressional-Constituent Communication System

*Citizen feedforward = communication of constituent perceptions, values, goals, and strategies to congressmen.
Congressional feedforward = communication of congressional perceptions, values, goals, and strategies to constituents.
Citizen feedback = communication of citizen opinions and views in response to congressional action and effects on the real world flowing therefrom.
Congressional feedback = communication of congressional action in response to citizen feedforward and feedback.
Participatory dialogue = mutual exchange of information and meaning between and among congressmen and their constituents about alternative perceptions, values, goals, strategies, and actions.

Politics and the Media: The Goal of Balanced Access

Any approach to the allocation of political access to communication media must be based on a value judgment of some sort. In the view of this writer, the basic goal should be to achieve fair and balanced access to communication channels for both incumbent office-holders and challengers. A minimum level of access should be guaranteed to all eligible and qualified candidates in order to achieve a reasonable balance of exposure between the incumbent and challengers, and to increase the flow of information to and dialogue with the voters.[17]

To realize this goal with broadcast television, some have proposed the "voters' time" concept which would require television stations to make available specified amounts of time under clearly defined conditions for the purpose of political broadcasts by candidates for the House or Senate. "Voter's time" would be provided free of charge to candidates, with costs absorbed either by the stations as a public service or by the federal government through some sort of public campaign financing.[18]

While this approach has merit, and should be pursued, it does not solve the problems inherent in the technical and economic limitations of broadcast TV, and has generated considerable opposition on this basis. In addition, the problems of eligibility, use, and especially allocation have proved difficult to resolve.

As discussed earlier, cable technology can help overcome the technical and economic limitations. And cybernetics can help show how cable could be used so as to improve the political campaign process.

A Cybernetic Approach to Access Allocation

Full equality of access for every candidate, even if possible, might well be harmful. While opportunity for expression and right of access to

communication forums are essential to democratic politics, the political communication system must also keep social stability in balance with social change. Unlimited political communication can lead to communication overload, distortion, and stress which in turn could threaten the viability of the political system itself.

Cybernetics has now developed to the point where it can provide some guidance, albeit tentative, as to how a balance can be struck between stability and change, incumbents and challengers, the "ins" and the "outs."

What follows below is an exploratory application of cybernetics, presented in non-technical language, for the allocation of cable origination time to congressional candidates. The allocation methodology is based on the "modified thermodynamic imperative," a cybernetic hypothesis which suggests that the optimum balance between stability and change (order and freedom) in society can be achieved in part by maximizing the entropy of communication (known as negentropy).[19]

The long range objective should be to fully realize the potential of cable television for an improved political dialogue. During primary and general election campaigns for the U. S. Congress (and perhaps for others of local importance like the city council, county board of supervisors, or state assembly), all qualified candidates should have access to cablecasting facilities and origination channels under clearly defined conditions of eligibility, allocation, and use.

But access must be controlled so as to preclude the possibility of communication overload or abuse. The idea proposed here is to move from the present "equal time" rule, which is clear-cut but tends to result in the provision of little or no time and thereby restrict political communication, to the concept of "representative time."

Under a "representative time" provision, eligibility might be defined by limiting access to those legally qualified candidates who (1) represent a political party whose candidate placed first or second in the previous election, (2) represent a political party recording a specified percentage of the total vote in the previous election, (3) receive a designated level of support in voter opinion polls, or (4) gather a given number of voter signatures as evidence of an acceptable minimum level of support.[20]

Candidates qualifying under these eligibility rules might then be allocated free time according to specified formulas. For example, one-half of the total time available could be alloted on a major-minor-third party proportional basis to assure adequate exposure for candidates of the organized political entities. The other half of the time could be allocated on an individual probability basis to guarantee at least some exposure for independent candidates.

As illustrated in Figure Two, allocation on a party proportional basis favors the established and majority political interests while allocation on an individual probability basis favors the independent and minority political interests. Thus the total combined allocation provides an equitable and efficient balance of representation between established-majority and independent-minority political expression and exposure.

In the example of Figure Two, 20 hours is the total "representative time" available over cable origination channels for a particular congressional general election campaign. One-half of the total--ten hours--is allocated among party candidates in direct proportion to each party's percentage of the total vote in the previous general election. Thus, major party candidate A receives five hours based on party A's 50% of the total vote,

Figure Two. Illustrative Allocation of Cable Origination Time to Congressional Candidates

Candidate	Party Proportional Allocation		Individual Weighted Probability Allocation				Total Combined Allocation (in hours)
	Percentage Vote**	Hours Allocated	Support Probability*	Weighting Factor	Weighted Probability	Hours Allocated	
A. major party	50	5	0.45	0.518	0.269	2.69	7.69
B. major party	30	3	0.325	0.531	0.275	2.75	5.75
C. third party	15	1.5	0.10	0.332	0.172	1.72	3.22
D. minor party	5	0.5	0.08	0.292	0.151	1.51	2.01
E. independent	0	0	0.03	0.152	0.079	0.79	0.79
F. independent	0	0	0.01	0.066	0.034	0.34	0.34
G. independent	0	0	0.005	0.038	0.020	0.20	0.20
Totals	100.0	10.0	1.000	1.930	1.000	10.00	20.00

**Percentage vote of each candidate's party out of the total vote in the preceding election.

*Support probability measured by voter preference polls or the number of signatures collected by the candidate as a percentage of total registered voters.

Candidate	Party Proportional Allocation (in hours)	Individual Probability Allocation (in hours)	Total Combined Allocation (in hours)
A. major party	5	2.69	7.69
B. major party	3	2.75	5.75
C. third party	1.5	1.72	3.22
D. minor party	0.5	1.51	2.01
E. independent	0	0.79	0.79
F. independent	0	0.34	0.34
G. independent	0	0.20	0.20

Source: See Appendix A for allocation formulas; allocation methodology based on Frederick Bernard Wood, "The Use of Cybernetics to Solve An Employee Communication Problem," in Careers and the MBA, ed. Fred B. Wood (Boston: Harvard Business School, 1970), pp. 43-47, and "Allocation of Supplementary Public Exhibit Space By Negentropy of Membership Statistics," Communication Theory in the Cause of Man 1 (August/September 1970): 9-11.

major party candidate B receives three hours based on a 30% vote, and so forth.

The other ten hours is allocated among all candidates--both party and independent--according to each individual's weighted probability of support as measured by voter opinion polls or number of voter signatures collected.[21] The effect of the weighting factor is to partially offset the advantage accruing to major party candidates from the proportional allocation.

Under the weighted probability allocation, minor party candidate D with an 8% level of support receives 1.51 hours, independent candidate E with only 3% support receives 0.79 hour, and so on. By comparison, major party candidate A with 45% support receives but 2.69 hours. Of course, when the proportional and weighted probability allocations are combined, in this example the two major party candidates together still get more than 65% of the total time available. But the net effect is to maintain a balance of representation which makes efficient use of the available time while guaranteeing an equitable allocation among majority, minority, and independent candidates.

This approach to eligibility and allocation will obviously be more complex to administer that the current "equal time" practice. But, as Figure Two and the foregoing discussion are intended to demonstrate, the concept of "representative time" can be hammered down into specific and workable terms which will become increasingly feasible, either via the current or an expanded broadcast television system or when cable television achieves significant penetration into the local political marketplace.

A final aspect of "representative time" is the conditions of use. Use here should be restricted to formats which are "intended to promote rational discussion, illuminate campaign issues, and give the voter insights

into the abilities and personal qualities of the candidates," and which avoid "excesses, deception, distortion, fraud, and exaggeration in campaign tactics."[22] It might even be reasonable to require that some portion of the total time be used in a debate format with opposing candidates and in a discussion format with community and news media representatives.

In Conclusion: Strengthening Our Constitutional Rights

Perhaps the most important aspect of this exploratory approach for the allocation of political access to the media is the potential for a reaffirmation and positive reinforcement of basic constitutional rights, as interpreted in light of modern day political and technological reality.

Telecommunication already plays a major part in American political life. The effective exercise of the inherent constitutional right to seek and hold public office and the First Amendment freedom of (political) speech is likely to increasingly require the right of access to communication forums. In the unfolding Communication Era, new physical technologies like cable television provide the opportunity for such access.

Can cable's capability be adapted so as to reinforce these basic political rights and at the same time contribute to the effective management of social change and resolution of pressing social problems? My judgment is yes. Through creative use of cybernetics, coupled with further research and the education of both our citizens and leaders, the groundwork can be laid for a public policy on political use of emergent telecommunication which truly reflects the public interest.

APPENDIX A

FORMULAS FOR ALLOCATION OF CABLE ORIGINATION TIME TO CONGRESSIONAL CANDIDATES

T = Total available cable origination "representative time" = T

Proportional Allocation Formula	Weighted Probability Allocation Formula
Percentage vote = v_i	Support probability = p_i
Time available for proportional allocation = $T_v = aT$	Time available for weighted probability allocation = $T_p = (1 - a)T$
In this example $a = 0.5$	
Therefore $T_v = 0.5T$	Therefore $T_p = 0.5T$
	Weighting factor = $-p_i \log(p_i)$
	Weighted probability = $\bar{p}_i = \dfrac{p_i \log(p_i)}{\sum p_i \log(p_i)}$
Proportional time allocated to each party candidate = $v_i T_v$	Weighted probability time allocated to each legal candidate = $\bar{p}_i T_p$

Total time allocated to each candidate = $T_i = v_i T_v + \bar{p}_i T_p$

Footnotes

*This article is based on portions of the author's "Telecommunications Technology for Congress: An Exploratory Assessment of Its Potential for Congressional-Constituent Communication," doctoral dissertation in management science and public administration, The George Washington University, Washington, D.C., September 1974.

[1]See Frederick Bernard Wood, "Three Eras of Civilization," Communication Theory in the Cause of Man 1 (January/February 1971): 13-14.

[2]See, for example, Bernard Rubin, Political Television (Belmont, Ca.: Wadsworth, 1967); Edward W. Chester, Radio, Television, and American Politics (New York: Sheed and Ward, 1969); David A. Leuthold, Electioneering in a Democracy: Campaigns for Congress (New York: John Wiley, 1968); Robert J. Huckshorn and Robert C. Spencer, The Politics of Defeat: Campaigning for Congress (Cambridge, Ma.: MIT Press, 1971); and the Twentieth Century Fund, Electing Congress (New York: Twentieth Century Fund, 1970).

[3]"FCC: Use of Broadcast Facilities by Candidates for Public Office." Federal Register 35 (15 August 1970): 13048-13167: and Sec. 315 of the Communications Act of 1934 for statutory authority.

[4]See Wood, "Technology for Congress," pp. 147, 166, 293.

[5]Television Digest, Television Digest CATV Atlas, 1973. For a discussion of cable history see, for example, Sloan Commission on Cable Communications, On the Cable: The Television of Abundance (New York: McGraw-Hill, 1971), and Ralph Lee Smith, The Wired Nation (New York: Harper and Row, 1972).

[6]CATV Atlas; and Walter S. Baer, Cable Television: A Handbook for Decision-Making (Santa Monica, Ca.: RAND Corp., February 1973), p. 7.

[7]Ibid.

[8]For extensive discussion of cable regulatory, political, and economic considerations, see, for example, Steven R. Rivkin, "The Changing Signals of Cable TV," Georgetown Law Journal 60 (1972): 1475-1511; Roscoe L. Barrow, "The New CATV Rules: Proceed on Delayed Yellow," Vanderbilt Law Review 25 (May 1972): 681-724; and Martin H. Seiden, Cable Television U.S.A.: An Analysis of Governmental Policy (New York: Praeger, 1972).

[9]Ibid.; also see Steven R. Rivkin, Cable Television: A Guide to Federal Regulations (Santa Monica, Ca.: RAND Corp., March 1973).

[10]Baer, Cable Decision-Making, p. vii; Rivkin, Cable Regulations, chap. 1

[11]See Norbert Wiener, Cybernetics: Or Control and Communication in the Animal and the Machine (New York: John Wiley, 1948).

[12]For Wiener's interpretation of the future social implications of cybernetics, see his The Human Use of Human Beings: Cybernetics and Society (New York: Doubleday, 1954).

[13]Based on Charles R. Dechert, "The Development of Cybernetics," in The Social Impact of Cybernetics, ed. Dechert (New York: Simon and Schuster, 1966), pp. 14-15, 20, 34; Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations (New York: John Wiley, 1966), p. 223; and Stafford Beer Decision and Control (New York: John Wiley, 1966), pp. 253-61.

[14]For alternative approaches, see, for example, Stafford Beer, "The World We Manage," Behavioral Science 18 (May 1973): 198-209; Noam Lemelshtrich, Design Analysis of A Home Terminal for Two Way Communications (New York: Center for Policy Research, February 1972); and Chandler H. Stevens, "The Institutionalization of Feedback, Feedforward, and Dialogue," mimeographed, May 15, 1972.

[15]See Stafford Beer, "Managing Modern Complexity," in The Management of Information and Knowledge, ed. U.S., Congress, House, Committee on Science and Astronautics (Washington, D.C.: Government Printing Office, 1970), pp. 41-62.

[16]Ibid.

[17]See statement of Sig Mickelson, Director, Aspen Institute Project on Politics and the Media, in U.S., Congress, Senate, Committee on Commerce, Subcommittee on Communications, Federal Election Campaign Act of 1973, Hearings, 93rd Congress, 1st Session (Washington, D.C.: Government Printing Office, March 1973), pp. 104-108.

[18]Voter's time has been proposed for presidential campaigns in The Twentieth Century Fund Commission on Campaign Costs in the Electronic Era, Voters' Time (New York: Twentieth Century Fund, 1969), and in a later Fund study by Newton N. Minow, John Bartlow Martin, and Lee Mitchell, Presidential Television (New York: Basic, 1973). Reps. John Anderson and Morris Udall have made a similar proposal for congressional campaigns in U.S., Congress, House, Clean Elections Act of 1973, H.R. 7612, 93rd Congress, 1st Session, Title VI.

[19]For extensive technical discussion, see Frederick Bernard Wood, Communication Theory in the Cause of Man 1 and 2 (1971, 1972).

[20]Criteria of eligibility derived from Michael J. Baker, "Constitutional Remedy for the High Cost of Broadcast and Newspaper Advertising in Political Campaigns," California Law Review 60 (September 1972): 1414; and U.S., House, Clean Elections, pp. 27-28.

[21]The weighted probability is determined for each candidate by multiplying the raw probability of support by a weighting factor based on Claude Shannon's definition of the measure of information in a message as being proportional to the logarithm of the probability. This approach to the allocation of communication space was originally applied by Dr. Frederick Bernard Wood. For extended discussion, see his "The Use of Cybernetics to Solve An Employee Communication Problem," in Careers and the MBA 1969, ed. Fred B. Wood, (Boston: Harvard Business School, 1970, pp. 43-47, and "Allocation of Supplementary Public Exhibit Space By Negentropy of Membership Statistics," Communication Theory in the Cause of Man 1 (August/September 1970): 9-11.

[22]U.S., House, Clean Elections, pp. 20-24; Mickelson, p. 105.

On Lindsay's Thermodynamic Imperative

By Byron Hale

With reference to the statement of Lindsay's Thermodynamic Imperative from CTCM Vol. 1, No. 3-4, p. 17, as follows: "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."

- The term "order is misleading, particularly when the system to which it is applied is vaguely defined. A heat engine is an "orderly" system, but the burning gases are not "orderly". The free energy of the gasses is "ordered" by the engine which constrains the gasses. Thus, a combination of "order" and "disorder" is necessary for repeatable but productive work.

- The "order" to which Lindsay alludes is "objective" — order in the thermodynamic sense. However, the "order" which we need in our own lives is subjective or personal to the individual. This subjective order is associated with the order of an open system, the only type order that can undergo a net increase. One person's order may be another person's "disorder". Some persons might interpret the admonition: "increase the degree of order" to mean that the world be harnessed to the will of a single individual.

- "Objective" entropy is never diminished (in accordance with the Second Law of Thermodynamics). So if objective entropy were consumed (internalized?) the consuming organism should be disordered. A competitive swimmer depends on a supply of cool water to maintain thermal homeostasis and compete at the same time. Sufficiently warm water would force the swimmer to contain the waste heat of exercise and to absorb heat from the water as well, throwing homeostatic balance off. Clearly, Lindsay cannot mean the consumption of such waste when he writes "consume as much entropy as possible".

  Subjective entropy is only applicable when the items are suitable for the system states of the organism. An urban dweller may regard horse manure and hay as equally useless, while a horse will prefer the hay. Humans cannot live on hay, but horses can.

Perhaps some form of work (low entropy or negentropy export) is Lindsay's intent. Even so, there is always an entropy penalty associated with this work. In social terms, this has sometimes meant that some people have become "disordered" as the result of other people's work. In one such case, a group of people with syphilis was deliberately allowed to go untreated (without the knowledge of the group) because these people were seen as a control group in an experiment. Lindsay's "Thermodynamic Imperative" is not suitable as an ethical premise.

Section 3.7.1: Thermodynamics (Continued)

The first and second laws of thermodynamics described in Section 3.7.1 (CTCM II/5 pp. 27-28) are generally considered a part of "macroscopic thermodynamics" – i.e., the thermodynamics of large systems in which the average temperatures, heat contents, entropies, etc., are considered. There is also a branch of thermodynamics called "microscopic thermodynamics" in which the statistics of the motions of individual molecules are analysed. Generally the analyses of micro-thermodynamics lead on the average over a large number of particles to the classical laws of macro-thermodynamics. This is explained by Myron Tribus in the American Scientist, vol. 54, no. 2, 1966, pp. 201-210, "Micro- and Macro-Thermodynamics."

In an earlier article Tribus[1] derives the principal laws of thermostatics and thermodynamics from a simple set of postulates and the principles of information theory[2] using Jaynes'[3] proposed formalism for statistical inference.

There is another approach from thermodynamics to sociological problems, namely to start from the Gibbs' formula for the total differential of the entropy of a chemical system[4]. George Lamb[5] has developed by analogy an entropy-like property of social systems called "informtropy" and an analogy to chemical energy for social systems called "informenergy." It is planned to explore, in a future issue, how George Lamb's approach can be tested.

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[1] Myron Tribus, "Information Theory as the Basis for Thermostatics and Thermodynamics," General Systems, vol. VI, 1961, pp. 127-138.

[2] Claude Shannon and Warren Weaver, Mathematical Theory of Communication, University of Illinois, 1949.

[3] E. T. Jaynes, "Information Theory and Statistical Mechanics," Physical Review, vol. 106, no. 4, pp. 620-630 and vol. 108, no. 2, pp. 171-190 (May 15, 1957 and October 15, 1957).

[4] "Thermodynamics, Characteristic Functions In," section in The International Dictionary of Applied Mathematics (1960 edition), p. 943, New York: D. Van Nostrand Co.

[5] George G. Lamb, "Knowing and Guessing about Societal Change-I: Evolutionary Learning Processes," address for Jan-Oct: 1856 Sherman, Evanston, IL 60201; for Nov-Jan: 2180 '0' Via Puerta, Laguna Hills, CA 92653; conference paper presented at Far West Region, Society for General Systems Research, Sacramento, California, Oct. 24-25, 1974.

Section 3.9.4: Reviews of Books and Articles Relevant to Mathematics, Science, and Testing of Hypotheses

Toby Berger, Rate Distortion Theory: A Mathematical Basis for Data Compression. Englewood Cliffs, N.J.: Prentice-Hall (1971)

This book is devoted to the branch of Information Theory in which situations are encountered where the entropy of the source exceeds the capacity of the communication channel.

This book is reviewed by Robert M. Gray, Associate Professor of Electrical Engineering, Stanford University, in IEEE Transactions on Information Theory, Vol. IT-18, No. 1, Jan 1972, pp. 217-218.

Section 6.4, "Biochemical Data Compression," of Prof. Berger's book is described by Prof. Gray as "a somewhat visionary discussion of possible applications of rate-distortion theory of chemical, biological, and electronic information gathering systems. Whether fantasy or wave of the future, this section provides an enjoyable detour."

This same section which is questioned by the above reviewer is of particular significance to the material being developed in COMMUNICATION THEORY in the CAUSE of MAN. Prof. Berger describes the process similar to rate distortion analysis of infosystems that occurs in chemical equilibria problems through defining the Gibb's free energy and deriving a quantity that is minimized in the multiphase equilibrium problem. The equation for the chemical equilibrium problem is analogous to the process in electrical communication theory. Prof. Berger then discusses an analysis of the kidney from an

information-theoretic viewpoint made by Johnson and Knudsen[1]. They conclude that by taking into account the information-theoretic energy terms in analyzing the kidney function, an efficiency of between 30 and 40 per cent is found compared to the 1 per cent computed by previous methods based solely on fluid thermodynamics. Prof. Berger qualifies this whole section 6.4 by stating that his section is purely speculative, but hopefully provocative.

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[1] Horton A. Johnson & Knud D. Knudsen, "Renal* Efficiency and Information Theory," Nature, May 29, 1965, Vol. 206, No. 4987, pp. 930-931.

If we go into Johnson and Knudsen's paper in detail, there open up possibilities of verifying George G. Lamb's approach to examining social systems by analogy from thermodynamics, provided we pay careful attention to the referenced work of Jaynes and Tribus. (See Magazine III/3, p. 29 or Book Section 371, p. 3)

* "Renal" is defined as "relating to, or located in the region of the kidneys."

Section 3.9.6: Questions (Continued)

Question 25: What is the usefulness of Lindsay's "Thermodynamic Imperative"?

The criticism by Byron Hale of Lindsay's "Thermodynamic Imperative" in Sec. 3.3.1 of this issue may on the surface appear to be attacking a basic premise of the magazine and cumulative book, COMMUNICATION THEORY in the CAUSE of MAN. The use of the "Thermodynamic Imperative" in this series was adopted for two reasons:

(1) The basic concept to be developed is the "consistency of principle of political and religious freedom with maximizing negentropy." (Socio-Engineering Problems Report No. 19-A, various version from 2/18/57 to 1/4/62) Since I was not able to get papers discussing this concept published in any traditional engineering or scientific journals, I searched for the nearest principle that was published in scientific journals. I found that Lindsay's "Thermodynamic Imperative" was published in the American Scientist and a number of books on philosophy and science. By referencing the published work of Lindsay, I felt that readers would have a starting point in the published literature.

(2) I considered that Lindsay's "Thermodynamic Imperative" could be used as a "heuristic"* tool in the learning process of finding how information theory

*"Heuristic" is defined as "serving to guide, discover, or reveal; specifically: valuable for empirical research but unproved or incapable of proof."

could be applied to understanding social systems, and that the "Thermodynamic Imperative" would probably have to be modified in the process. The discussions in Book Sections 1.0.2, 2.3.2A, 2.3.2B, and 2.3.2 indicate a move to modify Lindsay's "Thermodynamic Imperative," and contain some proposals for such modification.

Byron Hale has shown that there are further difficulties with the "Thermodynamic Imperative." His comments are an important contribution in the heuristic process of finding a more accurate way of expressing the relationship of maximizing some entropy-like property of a social system as an ethical principle. I believe that Lindsay correctly perceived the possibility of an ethical principle related to entropy, but his formulation of the "Thermodynamic Imperative" is too oversimplified to be correct. I think that a study of the work of Jaynes, Tribus, and Lamb mentioned in Book Section 371 may lead to a formulation of a similar principle, but based on Information Theory, not Thermodynamics.

Frederick B. Wood