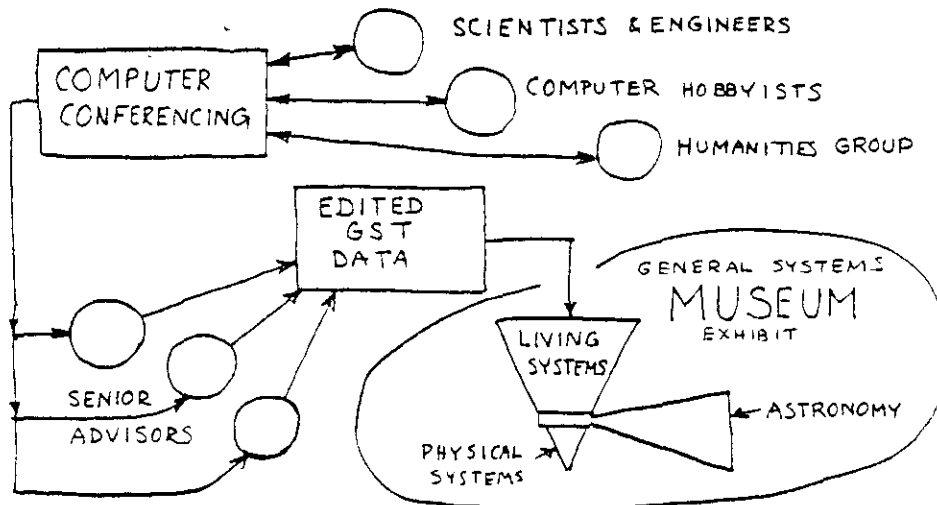
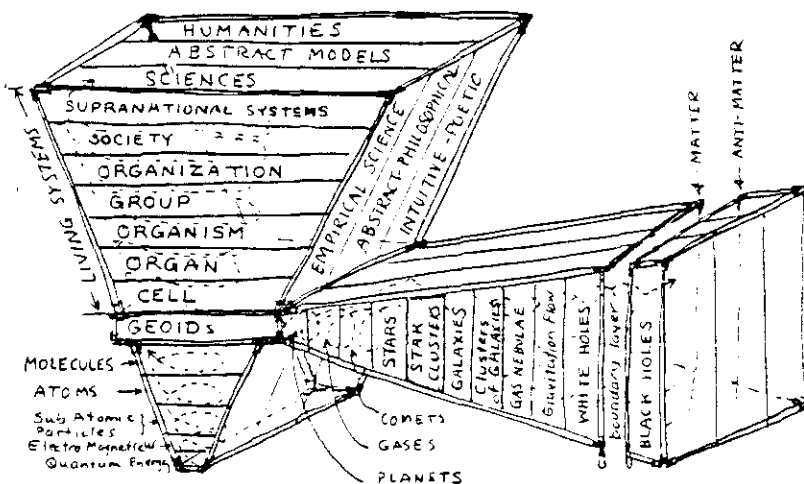


# COMMUNICATION THEORY in the CAUSE of MAN

Notes on the application of General Systems Theory, Cybernetics, Information Theory, and related fields of Communication Theory to the strengthening of democratic institutions on our planet.

### INSIDE THIS ISSUE:

A Proposal for a Quasi-Completeness Test of General Systems Theories using Computer-Conferencing and Computer Data Base Searching Coordinated with a Public Museum Exhibit Structure.



Price: \$1.75 per issue.

Update: F-25 -A

COMMUNICATION THEORY in the CAUSE of MAN, P.O. Box 5095, San Jose, CA 95150  
 Frederick Bernard Wood, Editor and Publisher

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SECTION 3.9.7: EDITORIAL NOTES.

I HAVE BEEN THINKING OF THE PAPER I GAVE TWENTY YEARS AGO ON THE SOCIAL RESPONSIBILITY OF ENGINEERS AND SCIENTISTS AT THE WESTERN JOINT COMPUTER CONFERENCE IN SAN FRANCISCO. I HAVE BEEN REVIEWING WHETHER THAT PAPER POINTED IN THE RIGHT DIRECTION. IT APPARENTLY DID FOR A PERIOD OF YEARS FOLLOWING THE PRESENTATION. NOW CONDITIONS HAVE CHANGED. MY 1959 PAPER WAS ORIENTED TOWARD A PARALLEL MODE OF OPERATION, WHEREBY AN ENGINEER WOULD WORK ON THE DEVELOPMENT OF COMPUTERS OR COMPUTER-COMMUNICATION SYSTEMS AND WORK IN PARALLEL IN THE EVENINGS AND WEEKENDS ON THE SOCIAL IMPLICATIONS OF THE WORK.

CHANGING CONDITIONS DURING THE LAST TWENTY YEARS INDICATE THAT THE PARALLEL MODE IS BECOMING LESS EFFECTIVE IN THE COMPUTER INDUSTRY. THEREFORE I FEEL A SWITCH TO A SERIAL MODE IS NECESSARY. IT APPEARS THAT THE TIME HAS COME TO LEAVE THE COMPUTER INDUSTRY AND SWITCH TO THE MOST IMPORTANT SOCIAL APPLICATION OF COMPUTERS THAT I CAN FIND.

WHAT IS THE MOST SERIOUS SOCIAL PROBLEM WHERE I CAN APPLY COMPUTER TECHNOLOGY? FOR THIS LET US SCAN THE "WASHINGTON POST" FOR ITS ATTITUDE TOWARD OUR CIVILIZATION AND ITS PROBLEMS.

IN MAY OF THIS YEAR BERNARD D. NOSSITER PUBLISHED AN ARTICLE IN THE "WASHINGTON POST", AND REPRINTED IN THE SAN FRANCISCO CHRONICLE AS "THE U. S. BRAIN TRUST: WHY IT'S BANKRUPT." NOSSITER INTERVIEWED LEADING UNIVERSITY PROFESSORS AND FOUND THERE IS NO LONGER ANY CONSENSUS ON SOCIAL AND ECONOMIC PROBLEMS IN ACADEMIA. THERE IS NO WAY THAT PRESIDENT CARTER COULD CALL UPON PROFESSORS TO SUGGEST SOLUTIONS AS PRESIDENT FRANKLIN ROOSEVELT DID.

THIS END OF CONSENSUS HAS DRIVEN MANY YOUNGER, BRIGHT ACADEMICS INTO A RETREAT FROM PUBLIC POLICY. NOSSITER REPORTS THAT AMBITIOUS ECONOMISTS ELABORATE ELEGANT MATHEMATICAL SOLUTIONS TO THEORETICAL PROBLEMS WITH LITTLE, IF ANY RELEVANCE TO PUBLIC ISSUES. SOCIOLOGISTS AND POLITICAL SCIENTISTS DEVOTE THEMSELVES TO TESTING AND EVALUATING PROGRAMS AND SCRUPULOUSLY AVOID A SEARCH FOR FRESH ANSWERS.

MY INTERPRETATION OF THIS SITUATION IS THAT HUMAN SOCIETY HAS REACHED A LEVEL OF ORGANIZATIONAL COMPLEXITY, SUCH THAT A NEW LEVEL OF ACADEMIC COOPERATION IS NEEDED IN ORDER TO UNDERSTAND THE COMPLEX SOCIAL PROBLEMS AND TO DEVELOP THEORIES USEFUL IN FINDING SOLUTIONS. I BELIEVE THAT (1) NO SINGLE INDIVIDUAL CAN HAVE BROAD ENOUGH EXPERTISE TO COME UP WITH VIABLE SOLUTIONS TO OUR SOCIAL, POLITICAL, AND ECONOMIC PROBLEMS, AND (2) NO SINGLE DISCIPLINE SUCH AS ECONOMICS, POLITICAL SCIENCE, OR SOCIOLOGY AS THEY ARE NOW ORGANIZED CAN COME UP WITH VIABLE PLANS TO DEAL WITH THE CURRENT PROBLEMS OF HUMAN CIVILIZATION. THIS REQUIRES BOTH GROUP COOPERATION AND A GENERAL SYSTEMS BASE TO FACILITATE DEALING WITH THE COMPLEX PROBLEMS.

FIRST I BELIEVE THAT NETWORKS OF INDIVIDUAL CITIZENS, POLITICIANS, AND SCIENTISTS HAVE TO BE ORGANIZED AND GO THROUGH A LEARNING PROCESS OF

DEVELOPING COOPERATIVE WORK ON MAJOR SOCIAL PROBLEMS. SECOND, I BELIEVE THAT A PROPERLY USED SYSTEM OF COMPUTER-CONFERENCING WITH A GENERAL SYSTEMS THEORY BASE CAN MATERIALLY SPEED UP THE PROCESS OF DEVELOPING A MORE PRACTICAL UNDERSTANDING OF HUMAN CIVILIZATION.

I AM DEBATING WHEN TO RETIRE FROM WORKING DIRECTLY IN THE COMPUTER INDUSTRY. I PLAN TO PURCHASE A HOME MICRO-COMPUTER WITH A TELEPHONE MODEM SO THAT I WILL HAVE THE TECHNICAL CAPABILITY OF DIALLING UP CONNECTIONS THROUGH SYSTEMS LIKE TELENET, TYMNET, ETC., FOR:

- (1) COMPUTER-CONFERENCING,
- (2) INFORMATION RETRIEVAL (SUCH AS VIA DIALOG),
- (3) TRANSMISSION OF SIMULATION PROGRAMS PREPARED ON A MICRO-COMPUTER TO RUN ON A LARGE COMPUTER (USING A COMPILER SUCH AS DYNAMO).

I PLAN TO CHOOSE A MICRO-COMPUTER WITH A POTENTIAL FOR COMPUTER GRAPHICS TO PERMIT "NON-VERBAL" INPUT SUCH AS DIAGRAMS TO COMPUTER-CONFERENCING. THIS EXTENSION MIGHT BE AN ELECTRONIC SKETCH PAD FROM WHICH DIAGRAMS COULD BE DIGITIZED INTO COMPUTER MEMORY. ALSO THE MICRO-COMPUTER FOR THIS APPLICATION SHOULD HAVE A CAPABILITY OF EXTENSION TO COLOR GRAPHICS, WHICH WOULD BE OF PARTICULAR VALUE IN THE PREPARATION OF PUBLIC MUSEUM DISPLAY CHARTS. THE ELECTRONIC SKETCH-PAD EXTENSION CAPABILITY IS ALSO RELATED TO A NEED FOR ACCEPTANCE OF DATA GENERATED BY EITHER RIGHT OR LEFT HEMISPHERES OF THE HUMAN BRAIN.

IN THE GENERAL SYSTEMS COMPUTER-CONFERENCING NETWORK, THREE KINDS OF DATA MUST BE ACCEPTED IN ORDER TO FACILITATE A COMPLETENESS CHECK:

- (1) "HUMANISTIC-INTUITIVE",
- (2) "ABSTRACT-MATHEMATICAL",
- (3) "EMPIRICAL-SCIENTIFIC."

FOR EXAMPLE, CREATIVE HYPOTHESES WITHOUT SUPPORTING EVIDENCE, SUCH AS BRYAN BERGSON'S "SOCIO-METABOLIC TRANSITION", COULD BE PUT IN THE "HUMANISTIC-INTUITIVE" SLOT, WHILE PITIRIM SOROKIN'S DATA ON THE RATE OF SCIENTIFIC DISCOVERIES AND INVENTIONS COULD BE PUT IN THE "EMPIRICAL-SCIENTIFIC" SLOT. THEN PARTICIPANTS IN THE GENERAL SYSTEMS COMPUTER CONFERENCING COULD ATTEMPT TO DEVELOP A MODEL IN THE "ABSTRACT-MATHEMATICAL" SLOT UPON WHICH BERGSON'S CURVES AND SOROKIN'S CURVES COULD BE PROJECTED, IN THE SENSE USED BY THE HISTORIAN OF SCIENCE, GERALD HOLTON, IN CONNECTION WITH THE PROJECTION ONTO THE THEMATIC PLANE.

A MORE FORMAL STATEMENT OF THIS PROPOSAL IS INCLUDED IN SECTION 2.8.0.

FREDERICK BERNARD WOOD

UPDATE F-25

SECTION 1.0.0B: "BLUE PAGE" PROJECT SUMMARY.

THIS "BLUE PAGE" IS INCLUDED TO HELP THE NEW READER OF THE MAGAZINE CTCM WHO HASN'T READ THE PRECEDING ISSUES GET A PERSPECTIVE OF THE SERIES. EACH ISSUE OF THE MAGAZINE CTCM CONSISTS OF ADDITIONS OR CHANGES TO THE CUMULATIVE BOOK 'CTCM.'

THE MAGAZINE 'CTCM' IS PUBLISHED IRREGULARLY. THE FIRST PUBLIC EDITION OF THE BOOK, "COMMUNICATION THEORY IN THE CAUSE OF MAN", WAS ISSUED IN OCTOBER 1973 AND CONSISTED OF VOLUMES I AND II OF THE MAGAZINE "CTCM" RECOLLATED IN SECTION (OR FILE) NUMBER SEQUENCE, EXCEPT THAT EDITORIAL NOTES AND MAGAZINE TITLE PAGES ARE MOVED TO THE BACK OF THE BOOK IN FRONT OF THE INDEX.

THE RECOLLATION OF SEPARATE ISSUES OF THE MAGAZINE IS FACILITATED BY THE INCLUSION OF BOTH MAGAZINE AND BOOK PAGE NUMBERS ON EACH PAGE OF EACH ISSUE OF THE MAGAZINE. THE BOOK SECTION AND PAGE NUMBERS ARE PRINTED ON THE LINE BELOW THE MAGAZINE PAGE NUMBER.

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. AS OF JUNE 1979 A CHANGE IS BEING CONSIDERED. ACCORDING TO NOSSITER OF THE WASHINGTON POST THE CONTEMPORARY SOCIAL SCIENTISTS DON'T HAVE MUCH TO OFFER THE LAYMAN AND POLITICIAN TOWARD THE SOLUTION OF OUR SOCIAL PROBLEMS. A SHIFT IN EMPHASIS IS BEING CONSIDERED TO MAKE THIS SERIES MORE USEFUL. THE STRUCTURE USED TO DATE HAS BEEN ORIENTED TO A CLASSIFICATION IN TERMS OF INFORMATION-DESTINATION. IT APPEARS THAT WE ALSO NEED MATERIAL ORGANIZED IN TERMS OF INFORMATION-SOURCE.

THE INFORMATION-DESTINATION CLASSIFICATION PUTS MATERIAL INTO PARTS FOR:

CITIZEN / DECISION-MAKER / SCIENTIST.

THE PROPOSED ADDITIONAL SECTIONS BASED ON THE INFORMATION-SOURCE CLASSIFICATION ARE:

HUMANISTIC-INTUITIVE / ABSTRACT-MATHEMATICAL / EMPIRICAL-SCIENTIFIC.

THE ABOVE CLASSIFICATIONS HAVE EVOLVED FROM THINKING ABOUT THE FOLLOWING QUESTIONS: 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. TWO DIAGRAMS ARE SHOW BELOW TO ILLUSTRATE THE SEPARATION INTO DIFFERNT SECTIONS.

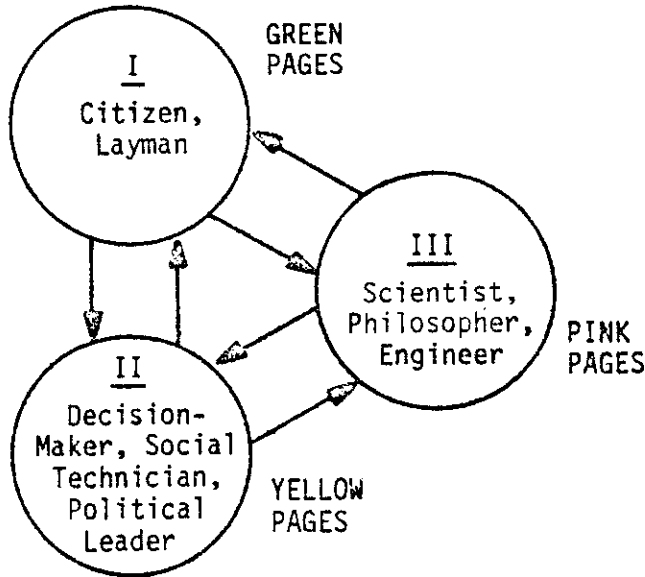
CLASSIFICATION SYTEMS:

INFORMATION-DESTINATION

100      200      300.  
 GREEN    YELLOW   PINK

INFORMATION-SOURCE

400      500      600  
 GREEN    YELLOW   PINK



±	(400)	±
±	SEC IV: HUMANISTIC-	±
±	INTUITIVE	±
±	(SECOND GREEN SECTION)	±
±		±

±	(500)	±
±	SEC V: ABSTRACT-	±
±	MATHEMATICAL	±
±	(SECOND YELLOW SECTION)	±
±		±

±	(600)	±
±	SEC VI: EMPIRICAL-	±
±	SCIENTIFIC	±
±	(SECOND PINK SECTION)	±
±		±

THE MATERIAL PROPOSED IN THE SECOND FORMAT (INFORMATION-SOURCE) WOULD ALREADY BE IN A FORM ADAPTIBLE FOR THE PROPOSED PUBLIC MUSEUM EXHIBIT STRUCTURE.

Section 2.8.0:

A PROPOSAL FOR A QUASI-COMPLETENESS TEST OF GENERAL SYSTEMS THEORIES  
USING COMPUTER-CONFERENCING AND COMPUTER DATA BASE SEARCHING  
COORDINATED WITH A PUBLIC MUSEUM EXHIBIT STRUCTURE

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ABSTRACT

A search for understanding of the instability of human civilizations in 1935 led to the hypothesis that we need engineers with sociological understanding working in industry to watch for clues as to how high technology civilizations break down. Various two and three dimensional charts were developed to visualize the relations between science, technology, and the humanities. Since 1954 with the cooperation of S.G.S.R. it has been possible to make more systematic charts to visualize the components of general systems theory. Now in 1979 a three-level computer data base of general systems knowledge is proposed to facilitate testing of hypotheses and to generate segments of a public museum exhibit. The indexing of the data bases would be keyed to sections of physical, astronomical, and living systems segments of the museum exhibit. Citizens could participate in computer-conferencing on the first level. Scientific society members could use both the first and second levels. Senior science advisors would edit what passes through to the third level to be made available to library computer search terminals.

INTRODUCTION

This paper is a mixture of systems science and autobiographical data for a specific purpose of providing academic sociologists with clues that might not otherwise be available to them. There is a conjecture that there is a sociological uncertainty principle similar to Heisenberg's uncertainty principle in physics. However, it appears that the sociological equivalent of

Planck's constant is not a constant, but a parameter that varies with time and between different societies. When one makes observations of social systems, both the organization and the observer may be changed in the process. Therefore, I feel it is important to include enough autobiographical material to provide sociologists clues to use in their research on the sociological uncertainty principle.

I was in high school as the Nazis were coming to power in Europe. I wondered how the leading country of the world in the arts and sciences, namely Germany, could change so quickly into a barbarian society. For a long time I have felt there must be something lacking in our understanding of the relationship between technology and society that permits the highest technology to slip into the hands of the barbarians. I concluded that our country needed to have people who understand the social implications of new technology. To do this we needed to have engineers at the interface between science and technology who had some training in sociology who could analyse the social implications in addition to accomplishing their assigned engineering work. I decided that I would be one of those engineers.

ENGINEERING AND SOCIAL SCIENCE STUDIES

At U.C. Berkeley I majored in electrical engineering, and tried to include some social sciences, but found that in the 1936-1940 era it was not practical to obtain cooperation between the engineering and social science faculties. I found a semi-underground method of

\*The views presented in this paper are solely the views of the author and do not necessarily represent any policies of the organizations with which he is or has been affiliated. The author is presently with International Business Machines Corporation, General Products Division, San Jose, California 95193. The work reported in this paper is a spin-off from computer-communications work done at IBM and from earlier and contemporaneous work done at Pacific Gas & Electric Co., M.I.T. Radiation Laboratory, University of California at Berkeley, San Jose State University, Northern California Association of Scientists, National

Council of the Arts, Sciences and Professions, Society for Social Responsibility in Science, Bay Area (San Francisco) Chapter of the Society for General Systems Research, Democratic Party Caucus, Common Cause, Arlington Street Church (Unitarian) of Boston, First Unitarian Church of Berkeley, First Unitarian Church of San Jose, American Friends Service Committee, Stiles Hall University Y.M.C.A. of Berkeley, Spartan Y of San Jose State, Technology and Society Committee of Palo Alto, the Midpeninsula Free University, and the I.E.E.E. Communications Society committee on Technology Forecasting and Assessment.

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learning social science in addition to my formal training as an electrical engineer. The churches and student YMCA and YWCA at the borders of the Berkeley Campus had series of seminars on current social and political problems. By attending these off-campus seminars I gradually built up an understanding of the current problems in the social sciences. From these activities I developed a chart to help me keep a perspective of all the specialized fields of human knowledge such as is shown in Figure 1. This chart was useful to me in maintaining a perspective while I was working on the development of RADAR and related weapons systems in the earlier part of World War II (Wood, 1971). I was trying to maintain a "balance" or "wholeness" or "completeness," while putting my principal efforts on development of weapons to defeat the Nazis. I felt that the retreat to barbarism of Germany was not a special case, but a possible development in any highly specialized technological society.

SPECIALIZATION POINTS TO TAKEOVER  
 BY BARBARIANS

The fundamental feature of a high technology society that makes it susceptible to breakdown and takeover by barbarians appeared to be the high level of specialization. If it were possible to develop a perspective of human knowledge that promoted the perception of overlaps between different fields of science, scientists and engineers might have a better chance of developing a sense of social responsibility. As a first step I tried to develop an improved perspective chart to replace Figure 1.

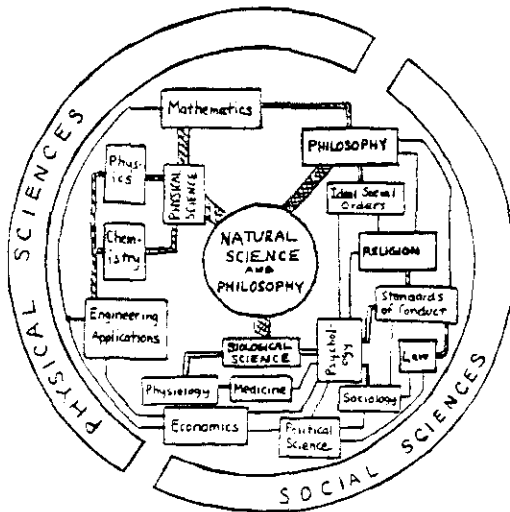


Figure 1. A Preliminary Attempt to Organize a Synthesis of the Specialized Fields of Science to Assist the Engineer in Developing an Interpretation of Science in Terms of Human Needs

I prepared cards for the topics and principal ideas considered by the young people's group at the Arlington Street Church in Boston for 1941-1942. Experimenting with a three-dimensional skyscraper model made from a toy "Erector" set, I found that the cards fitted a near optimum overlap of relationships when arranged to fit into the categories of Figure 2.

INTUITIVE SPIRAL RELATIONSHIP

I found that if the vertical columns of Figure 2 were transposed in certain ways there was an incomplete spiral connection between the topics in the skyscraper structure. Figure 3 illustrates the suggested form to develop the spiral form. Since my data were too vague, I put aside the spiral form. In the meantime I took the skyscraper model and my notes to some professors of sociology at Harvard University. They advised me that I was rediscovering the concepts developed by the early sociologists such as Auguste Comte, Herbert Spencer, and Lester Ward. My off-campus seminars on current sociological problems had not given me an adequate historical background in social science.

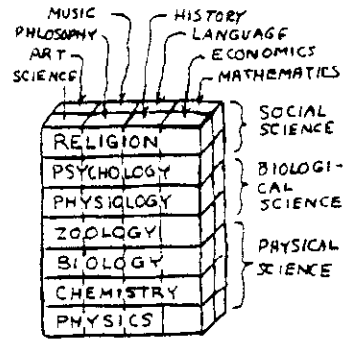


Figure 2. A Three-Dimensional Correlation

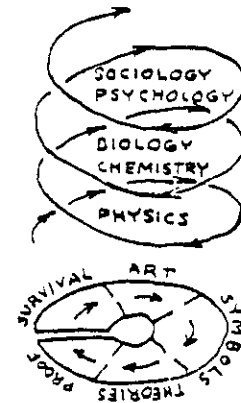


Figure 3. Spiral of Development

BACK TO SOCIOLOGY FUNDAMENTALS  
AND CIVIL LIBERTIES

It took some time to catch up on the history of sociology. Also, it took a few years of graduate study to obtain a Ph. D. in electrical engineering. In 1953 I took a job with IBM where I was again at the interface between new developments in science and the application of new technologies. I had planned to organize discussions of the social implications of new technology at the First Unitarian Church of San Jose. The McCarthy Era hysteria in the United States swept California along into a state supervision of churches such that religious organizations had to sign loyalty oaths to the government in order to retain their religious tax exemption. It took from 1953 to 1958 for the legal fight in the courts to get a favorable ruling from the U.S. Supreme Court that the California loyalty oath tax on religious organizations was unconstitutional. The court fight took a good deal of my spare time during that period.

SOCIETY FOR GENERAL SYSTEMS RESEARCH

The preliminary organizational meeting of the proposed Society for the Advancement of General Systems Theory in 1954 at the Center for Advanced Study of the Behavioral Sciences, Stanford, inspired me to renew my previous studies of the relationship between different fields of science. Figure 4 illustrates a checking chart for the social implications of computer-communications systems which would establish a universal credit system which could replace money (Wood, 1959).

EXTENSION TO COVER SCIENCES, ABSTRACT  
PHILOSOPHY, AND HUMANITIES

As I tried to extend this type of chart to other systems I found that the division between "Humanities" and "Science" was not adequate. I concluded that three divisions were more realistic, namely:

- Humanities: Intuitive, Poetic, Artistic, etc.;
- Abstract Models: Philosophical, Logical, Abstract, etc.;
- Sciences: Empirical, Experimental, Verifiable, etc.

A revised three-dimensional chart using the above categories is shown in Figure 5 (Wood, 1964). In this chart there are five levels: physical, chemical, biological, psychological, and social. There are three slices representing three methods: humanities, abstract-philosophical, and empirical-scientific. There are four horizontal classes of activity: basic laws or science, engineering or applied science, education, and decision and action.

Figure 5 illustrates how my own work relates to the more general fields of knowledge and skills. I have noted on the chart on the physical level where my past work fits in, such as Radar, Cybernetics, Information Theory,

Telephone Cables, Data Transmission with Error Feedback, Data Transmission Code Standards, and Computer Components and Programming. My original use of this chart was to plot possible spin-offs from the uses of cybernetics and information theory on the physical level to other levels. For example, there are similar negative feedback processes on each level of phenomena, but as we go from physical to social levels there is less and less mathematical precision. Similarly, there are entropy-like properties on each level. At the top level we have a possible correspondence between Albert Schweitzer's principle of "Reverence for Life" and some entropy-like property of a living system. Also, we can find properties of a political system in which an entropy-like measure gives us some understanding of the degree of democracy in the system (Wood, 1963). In the third column we have the property of information-input overload at all levels (Miller, 1960). In the fourth column we have a similar type of code in genetic coding as in what is called comma-free codes in electrical communication theory and in computer programming. On the psychological level there is a loose analogy to coding theory in the fragile equilibrium between "love" and "hate." In ideological coding we have the situation where people omit some facts about reality in order to have a simple concept of the world. This is similar to information compression without being able to precisely reconstruct the original message or picture accurately.

If widespread ideological coding occurs in political systems without being subject to test and verification, we are subject to possible future returns to barbarism, such as occurred in Germany in the 1930's. If we can correlate humanistic principles like "Reverence for Life" with computable entropy-like properties of social systems, we have a better chance of maintaining progress in human civilization with minor cycles of regression. I became impressed by the fulfillment of the predictions in the book Iron Heel by Jack London (1907) in the activities of the Nazis in Germany in 1934.

SPIRAL EVOLUTION IN CHEMISTRY  
AND SOCIOLOGY

I found an interesting book by Tomkeieff (1954) in which Mendeleev's periodic table of the chemical elements is transformed into a spiral form. This reminded me of the spiral form I described in Figure 3 and the possibility that the curves of social change of Sorokin (1948) might be projections onto a plane of a three-dimensional spiral. In January 1968, Bergson gave a talk to the Bay Area Group of S.G.S.R. at a meeting in San Jose where he described a spiral form of representing biological evolution that seemed to connect with the work of Tomkeieff and Sorokin.

At the S.G.S.R. meeting in Portland in September 1972, Bergson (1972) presented a paper on his spiral representation and Troncale presented a paper on

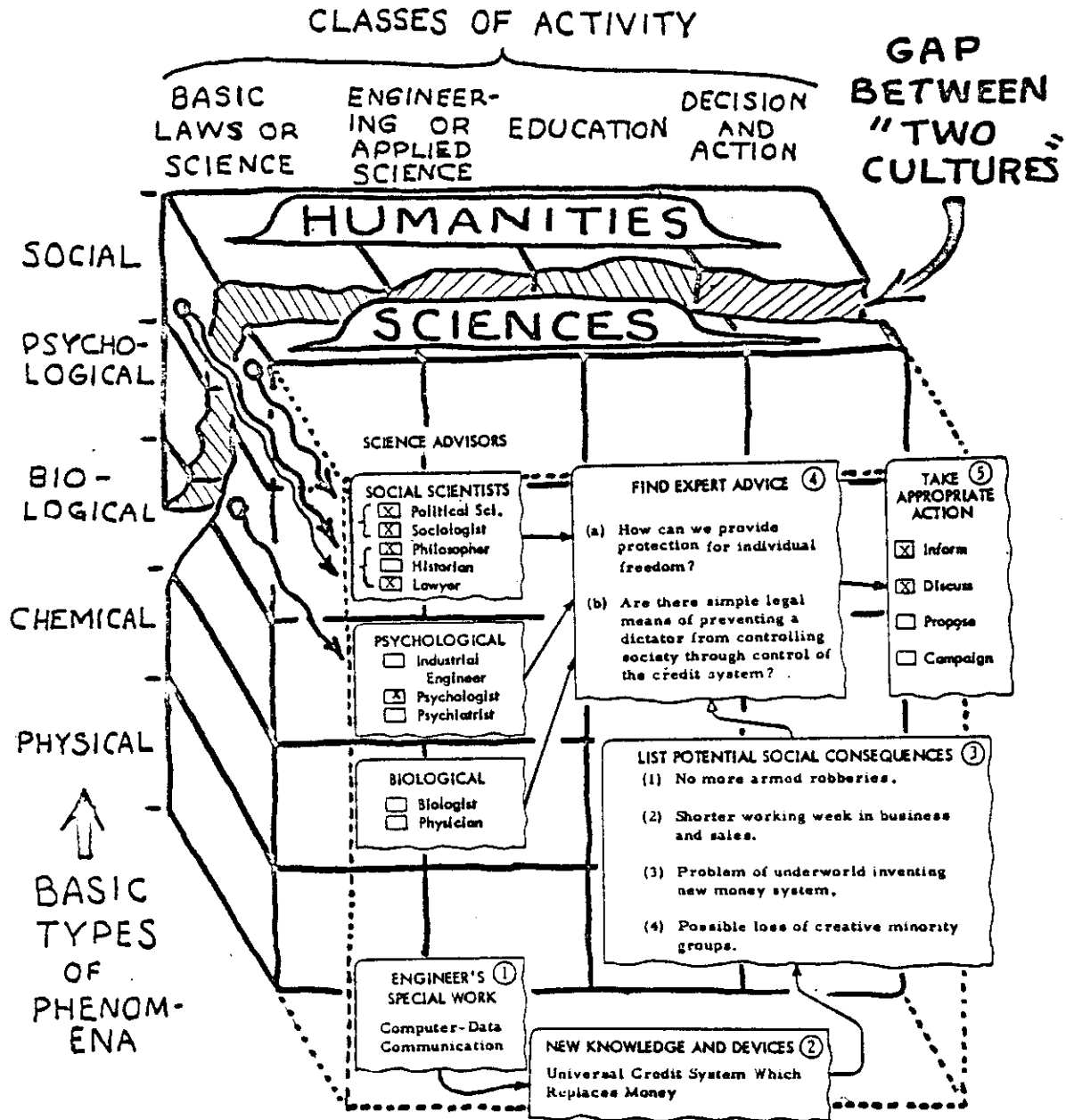


Figure 4. Extension of Three-Dimensional Chart to Visualize the Interaction of the Humanities and Sciences

hierarchies that resulted in spirals on a more universal scale (1972). Although these theories of spiral evolutionary curves are very important in the quality and stability of social systems, the primary purpose of this paper is to discuss the evolution of a quasi-completeness test for general systems theories. I think it is more expedient to direct attention to the particular variation of general systems theory for which we have the most information. I believe that J. G. Miller's Living

Systems (1978) of 1102+xii pages and 173 cross-level hypotheses fits this category.

COMPLETENESS THEOREMS IN MATHEMATICS

Now to get back to the fundamentals of a completeness test, in engineering where we use mathematical series in the solution of problems that are defined by differential equations, we can confer with mathematicians

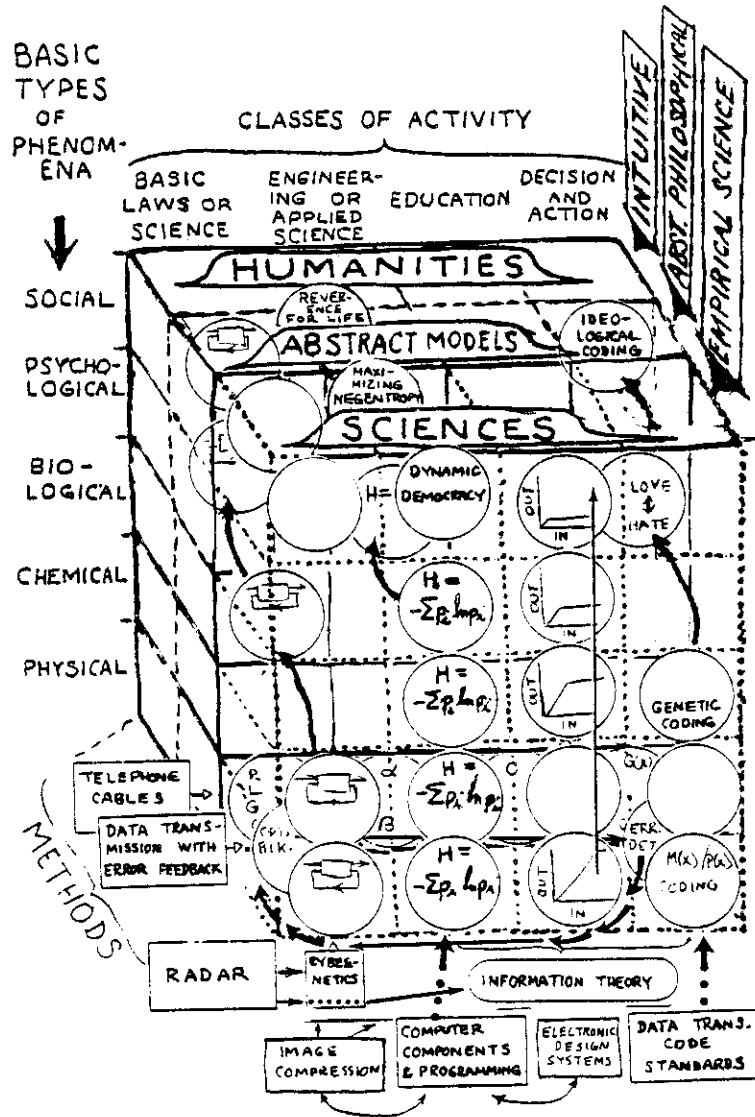


Figure 5. Relationship of my Own Work to the Three-Dimensional Chart of the Humanities, Abstract Models, and the Sciences

who can demonstrate a completeness theorem that tells us that the series we plan to use can represent a solution to our physical problem with any specified limit of error by using enough terms in the series. For example, the sawtooth waveform of Figure 6 has a decreasing error in Figure 7 when we use one, two, three, and four terms in the Fourier series representation.

I have learned from biologists that it is not possible to prove a completeness theorem for a mathematical model of a living system. I propose that we do the next best possible in testing systems hypotheses. I propose that we expand the three-dimensional chart of Figure 5 to

use as checklist for making sure that we have feedback from all segments of society. The system must also be visible to the public, such as having exhibits in museums and libraries.

#### MILLER'S LIVING SYSTEMS

James G. Miller's book Living Systems (1973) is the most comprehensive book published to date applying general systems theory to living systems. Miller and his associates identify 19 subsystems of living systems on seven levels: cell, organ, organism, group, organization, society, and supranational system. He lists

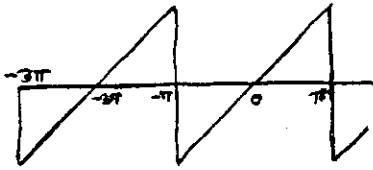


Figure 6. Sawtooth Waveform from Engineering to be Analysed by Fourier Series

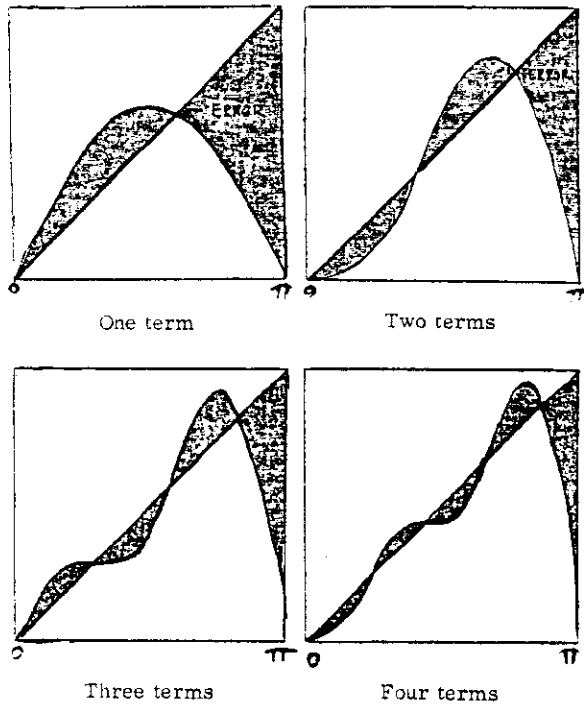


Figure 7. Error of Fourier Series Representation of Sawtooth Wave

173 cross-level hypotheses in language that is easily understood by biologists, communications engineers, and computer scientists. Of the 19 subsystems, two process both energy-matter and information, eight process matter-energy, and nine process information. These are listed in Figure 8.

I shall give some sample checks on the usefulness of Miller's Living Systems: (1) how organ level helps me in a systems analysis of my own health problems, (2) how on the organization level his hypotheses help me understand the problems of the organization (IBM), (3) how on the society level his hypotheses, with some additions, help us to understand problems of energy policy decisions, and (4) how scanning the humanistic-intuitive slice of the quasi-completeness testing chart turns up a

A) Subsystems which process both matter-energy and information:	
1. Reproducer	
2. Boundary	
B) Subsystems which process matter-energy	C) Subsystems which process information
3. Ingestor	11. Input transducer
4. Distributor	12. Internal transducer
5. Converter	13. Channels and Networks
6. Producer	14. Decoder
7. Matter-energy storage	15. Associator
8. Extruder	16. Memory
9. Motor	17. Decoder
10. Supporter	18. Encoder
	19. Output-transducer

Figure 8. Subsystems of Living Systems (Miller)

gap that needs to be filled in to insure a truly humanistic application of Living Systems.

First we consider that one or more replicates of Figure 8 fit into the front left column of Figure 5, a stack of two on the biological level for cell and organ; a stack of two on the psychological level for organism and group; and a stack of three on the social level for organization and society and supranational.

Earlier this year I had some eye trouble and a heart condition (tachycardia). I decided to do some research of the medical literature myself, and found that with my background of having studied Miller's Living Systems that it was much easier to select the right index terms in Index Medicus and the best computer search terms for a computer search of the Amsterdam, Netherlands, base Excerpta Medica computer files.

LIVING SYSTEMS AND MANAGEMENT SYSTEMS

In IBM for a number of years I have had confusing problems with IBM management. Sometimes I would receive conflicting messages from different lines of management in IBM, and my direct manager avoided the conflict. Following the articles in Behavioral Science upon which much of Living Systems is based helped me understand the nature of the communication problems in large organizations like IBM. In recent time IBM has successfully trained their managers to follow a standard procedure to avoid such conflicts. I have found the hypotheses in section 3.3.7 Decider in Living Systems helpful in understanding the confusion in

the chain of command in IBM. Also, I have found some deficiencies in these hypotheses. It appears to me that the hypotheses were developed by social scientists on the outside observing large organizations. It appears that there are some phenomena that are only easily observed by people at lower levels of the management hierarchy.

For example, consider "Hypothesis 3.3.7.2-4: The signature identifying the transmitter is an important determinant of the probability of the receiver complying with it." I have seen policy decisions with the same authoritative signature take one day, one month, and eight years to implement. The one day action involved product production plans and were associated with assignments of matter-energy. The one month action involved hiring policies and was accompanied by the appointment of compliance officers to see that the decision was carried out. The decision taking eight years to implement was skipped over by most managers due to the information input overload conditions described in Miller's Chapter Five (1978) until some employees raised enough objections to force the managers to read the appropriate sections of the manager's manual and management briefings. The higher levels of management have now learned to transmit some energy-matter along with an information message so that the accounting for the money (energy-matter) will provide feedback on how the directive is being carried out. Some of these apparent discrepancies with hypothesis 3.3.7.2-4 can be partially explained by a combination of hypotheses 3.3.7.2-11, 3.3.7.2-13, and 3.3.7.2-16. I think that a corollary to 3.3.7.2-4 needs to be developed to cover these problems more simply. More can be gained by applying Miller's hypotheses 5.2-21 and 5.2-22 to the above problems. It is possible that I have missed seeing relationships of some of the 173 hypotheses to these problems.

#### RECOMMENDATIONS

The complexity of dealing with Miller's 173 hypotheses and the many other general systems theories listed by Troncale (1977) leads me to believe that we need the three following things to help us make quasi-completeness tests of GST/s:

- (1) An open general systems theory computer conferencing network through which people, both professional and hobbyist, can communicate;
- (2) A restricted computer conferencing network through which senior advisors elected by various scientific societies can review the work developed by the first network and select that which is sufficiently verifiable for inclusion in a general systems encyclopedic data base; and
- (3) A three-dimensional framework upon which computer printouts from item (2) can be mounted in museums for inspection by the general public.

The connections between the above three parts are shown in Figure 9.

By means of the above recommendations, I propose that we become "on-line intellectual communities" in the sense discussed by Kochen (1977), which extended the computer-conferencing reviewed by Turoff (1974) and by Umpleby (1979). The use of the 173 hypotheses from Miller (1978) plus his classification of subsystems and his principal simulation models cited would provide a good start. To this data base we could add the major uncompleted work of the late Professors Dodd (1970) and Lamb (1970). Then we could add Haskell's (1972) and Bergson's (1978) differing spirals of evolution derived from the periodic table. Gordon Pask's systems science exhibit at the Brooklyn Children Museum inspires expansion to a more general concept of museum exhibits.

In 1907 the intellectuals ridiculed Jack London for his novel The Iron Heel, yet the essential features of social breakdown he described did occur by 1934. It is my hope that we can prevent the breakdown described by the novelist Sally M. Gearhart (1979) from coming to pass. We can make some progress by providing a computer terminal to Ritva Kaje, author of "Bringing the Feminine into Forecasting" (1977).

#### PROPOSED PUBLIC MUSEUM STRUCTURE

My attempts to place sections like Figure 3 in the appropriate cubes in Figure 5 led me to realize that although the 19 subsystems of Figure 8 appear on every level with few exceptions, that something, possibly the processes going on, increase on each higher level. This leads to a new three-dimensional diagram for use in testing the completeness of general systems theories. This new structure is shown in Figure 10.

Although my explorations of this method of a quasi-completeness test have so far been somewhat sketchy, I wish to mention two examples of trying out this type of procedure. One comes from studying the consequences of moving technology assessment procedures from the organization level to the society level. The other comes from trying to push the logical hypotheses over from the empirical slice to the humanistic slice.

#### SOLAR ELECTRIC EXAMPLE

The example of moving from the organizational level to the societal level relates to solar-electric power. The policy developed by ERDA and continued by DOE of projecting the development of solar semi-conductor cells such that a reasonable price will be obtained in 1985 has been described by Bacon and McWhorter (1975) and by Redfield (1978). The scientists at the Bellagio Conference chaired by Branscomb (1976) issued a concluding report in which the first goal was to "Improve the Process for Generating and Managing the Introduction

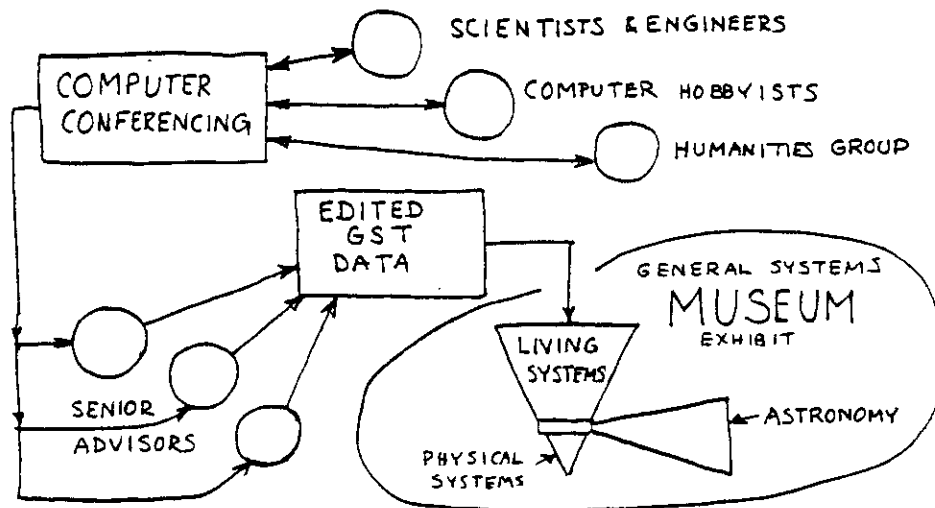


Figure 9. Computer-Based System of Updating Quasi-Completeness Tests of General Systems Theories and Producing Museum Exhibits

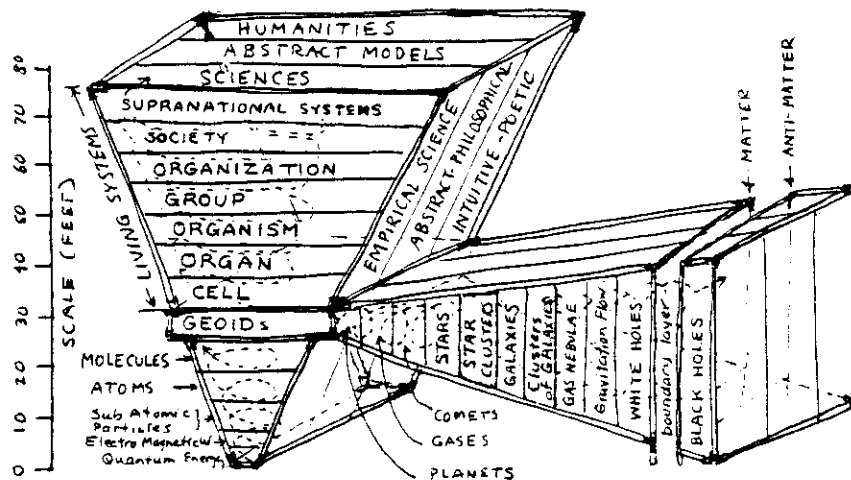


Figure 10. General Plan of General Systems Museum Exhibit

and Evolution of Technology." When I work with a background of using Miller's Living Systems with emphasis shifted through use of my concepts of a quasi-completeness test, I find that the DOE solar policy falls far short of the Bellagio Conference objectives.

The solar cell development projection curves are similar to the solid state circuit projection curves of 1964 upon which IBM based its computer policy development decisions which were correct decisions where one is limited to business and engineering efficiency. In 1964 a few IBM engineers objected strenuously that the decisions were blind to social consequences that many small

businesses might fail in the ten years before low-cost microcomputers would be available to them. At that time there was no technical arm of Congress such as the Office of Technology Assessment to which the engineers could appeal.

The pursuit of the DOE solar policy postpones solar-electric generation until inflation has wiped out the independent middle class in the United States, making a generation of retired people dependent solely on social security after their savings are wiped out by inflation (unless they were foresighted enough to put most of their savings in land). There is a technology available