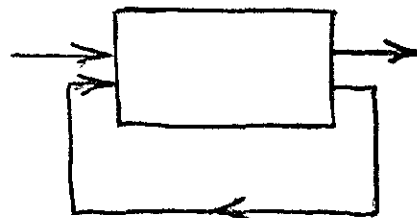A WORKING PAPER DRAFT

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SOCIO-ENGINEERING PROBLEMS

$$H = -\sum_i p_i \log p_i$$
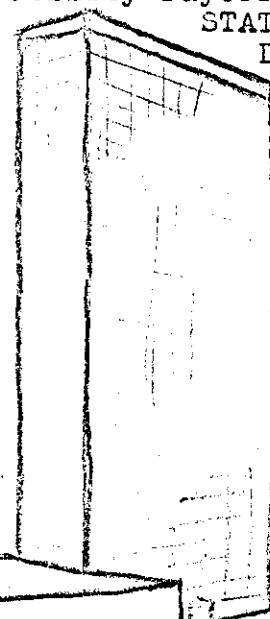
Information of Negative Entropy
in
INFORMATION THEORY

$$\begin{array}{c} & S_1 & S_2 \\ D_1 & \begin{bmatrix} u(D_1, S_1) & u(D_1, S_2) \\ u(D_2, S_1) & u(D_2, \\ u(D_3, S_1) & u(D_3, \end{bmatrix} \\ D_2 & \\ D_3 & \end{array}$$

Utility Payoff Matrix in
STATISTICAL
DECISION
THEORY

Negative Feedback Circuit
in CYBERNETICS

UNITED
NATIONS
Headquarters

APR–JUN

1959

No. 5

SOCIO-ENGINEERING PROBLEMS

A series of working paper drafts on the subject of the social
relations of engineering. This series of reports on ideas
developed in the pursuit of my hobby of considering the
potential analogies of various engineering concepts in the
social sciences as a way of establishing a technique for
engineers to discharge their responsibility for the social use
of their ideas and inventions. The function of this newsletter
is to provide a limited distribution of some preliminary ideas
for discussion prior to editing for submission to established
journals and engineering societies. In some cases no formal
publication is planned, since this medium of communication
will be used to suggest ideas to universities and research
institutes who are better prepared to develop the ideas.

Frederick B. Wood

Engineers' Council for Professional Development:

>"The engineer may be regarded, therefore, as an interpreter
>of science in terms of human needs and a manager of men,
>money, and materials in satisfying these needs."

This series deals with the function of the engineer as an "interpreter"
on the assumption that other people are dealing with the management
functions which many engineers acquire.

Problem 1.1: How can engineers develop some kind of perspective to
give them a synthesis of the specialized fields of science
needed for them to fulfil their function as an interpreter of
science in terms of human needs? The mention of "human needs"
raises many sociological questions.

Problem 1.2: What is the nature of the social responsibility of
engineers?

Problem 1.3: How can engineers help make the results of their work
be utilized in tune with mankind's highest aspirations as
stated by the major religious faiths?

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The discussions at the convention of the National Society of
Professional Engineers in San Francisco, October 24, 1958, were of
considerable significance in clarifying the dual role of the
engineer as (1) an individual in respect to professional matters
such as ethics, social responsibility, etc., and (2) as a part of
a collective group in respect to technical matters when employed
by a corporation or government agency.

Review of "TWO FAMOUS PAPERS."

Peter Elias, "Two Famous Papers." Institute of Radio Engineers Transactions on Information Theory, Vol. IT-4, No. 3, Sept. 1958, p. 99.

Dr. Elias describes two types of papers which have been written so often, by so many different authors under so many different titles, that they have earned editorial consideration.
"The first paper has the generic title 'Information Theory, Photosynthesis and Religion' ...., and is written by an engineer or physicist. It discusses the suprisingly close relationship between the vocabulary and conceptual framework of information theory and that of psychology (or genetics, or linguistics, or psychiatry, or business organization)........
"The second paper is typically called 'The Optimum Linear Mean Square Filter for Separating Sinusoidally Modulated Triangular Signals from Randomly Sampled Stationary Gaussian Noise, with Applications to a Problem in Radar.'

Dr. Elias concludes: "These two papers have been written--and even published--often enough by now. I suggest that we stop writing them, and release a large supply of manpower to work on the exciting and important problems which need investigation."

I have two strong reactions to Dr. Elias' editorial. I strongly disagree with him on the first paper, and heartily agree with him on the second paper. I shall omit detailed comments on the second paper since that is the area where I agree with Dr. Elias.

Returning to consideration of the first paper, I say that opposition to papers of the first class is obstructing the solution of important social and philosophical problems which must be solved to protect our civilization. I don't claim that such papers should be published in IRE Trans. on Information Theory or in Information and Control, but something more constructive needs to be done than to suggest that we stop working on them. If this class of papers are duplicating previous work or are superficial, the constructive step to take is to help these engineers and physicists establish contact with each other and with social scientists who can use their ideas on the use of concepts from information theory.

Dr. Elias stated further: "There is a constructive alternative for the author of this paper. If he is willing to give up larceny for a life of honest toil, he can find a competant psychologist and spend several years at intensive mutual education, leading to productive joint research."

I object to the insulting use of the term "larceny" here. Speaking for myself and such other engineers, scientists, and scholars whom I know to be interested in helping solve problems which require interdisciplinary effort, our interest consists primarily in helping establish contact with social scientists, so that work on these important problems can be expedited. The function of publication is to get working hypotheses to people geographically separated or isolated by being in different fields of specialization so that they will know of each other's interest, enabling them to cooperate by correspondence after the initial contact. It has been my own experience that the people likely to

be interested in discussing these interdisciplinary problems are
scattered around the world in London, Cambridge, NewYork, Chicago,
and Ann Arbor, while I am in San Jose. In the past I have been
unsuccessful in interesting local psychologists in these problems.
They have been interested more in industrial engineering problems
involving "human factors" studies and time and motion studies.

I have concluded that we don't have satisfactory communication
channels for the pursuit of interdisciplinary studies. Although
some progress has been made in the last year. We need a central
depository for manuscripts where individuals can deposit manuscripts
 and order microfilm copies of other's manuscripts from some kind
of an index. Scientific and engineering journals are organized to
report the results of scientific research and development. These
journals function is different than that required at this stage
of interdisciplinary research. What is needed here is the
exchange of problem statements, working hypotheses, and visions
of what might be accomplished.

To distinguish between these different stages of development of
a research project I have defined a series of stages starting
from "A", searching for background reference material, through
"T", preparation of more technical versions for social science
research. These stages are defined in the note on "Why a Working
Paper Draft?" Socio-Engineering Problems No. 3, pp. iii-iv, Oct-
Dec 1958. For this issue the challenge of Dr. Elias' criticism
of the first class of papers prompts me to revive an old manuscript
of mine on "The United Nations, Information Theory, Cybernetics,
and Decision Theory."

This material originally written in 1957 could be extensively
revised now. However I am duplicating it in its original form
and adding a list of the indicated problems to the conclusions.
In the future I feel that working paper drafts could be written
in forms more appropriate to the stage of development of the
content, i.e., working hypotheses should be written as questions
with tentative answers so that a reader would not have to know
my particular classification system of "A through T." For
example Dr. Mervyn Cadwallader has developed a format of an
"incomplete paper," in which the use of blank spaces and notes
in parentheses makes obvious the parts which are questions
requiring assistance of specialists from other fields.

To indicate what might be done to improve the communication of
incompoete ideas or working hypotheses, I have included an
appendix including some ideas presented by J. D. Bernal at the
International Conference on Scientific Information, Washington,
D.C., Nov. 16-21, 1958.

June 6, 1959   Frederick B. Wood

Revised July 3, 1959.

The United Nations, Information Theory

Cybernetics, and Decision Theory

The Challenge of the Earth Satellite:

At the Institute of Radio Engineers Aeronautical Communications Symposium in Utica, New York, November 7, 1957, the editor of Flying (magazine), Mr. Gill Robb Wilson, gave a challenging speech. He was gravely concerned over the failure of the United States to be first in launching a satellite into the "air environment". Mr. Wilson was upset by the situation in which a great country, having vast resources and democratic ideals with great respect for human dignity, failed to maintain leadership in such an important area of research and development as the earth satellite program. He was concerned that a "Godless" country like the Soviet Union was getting ahead of us in the training of scientists and engineers. He stated that our country is waiting for some great leader like Moses to show us the way out of the present situation. Mr. Wilson expressed a feeling of personal failure for not taking more vigorous action when he saw decisions being made in respect to research and development on the air environment which he felt were inadequate. He felt that in the United States we have failed to live up to our individual responsibility. He urged people who have an understanding of the important problems of our country to speak out and fight for consideration of their ideas.

My response to Mr. Wilsons' challenge is to examine the relation between science and society to see what problems exist in the United States and in the Soviet Union in a comparative way to see if any lessons can be learned from the situation. An all out expansion of our efforts in missles and satellites and in training of scientists may not be the answer. A simple push to catch up and overtake may be a brute force method dealing only with quantity or amount of effort. An examination of the structure or quality of what is going on may give us greater insight.

Information Theory in the USSR

Evaluation of the information theory developments in the Soviet Union as reported at the Western Electronics Show and Convention (WESCON), August 1957, leads to some interesting hypotheses. Namely, the leaders of the Communist Party of the Soviet Union were initially afraid of the political implications of information theory. The most plausible explanation of the opposition to pursuit of information theory, is the potential analogy of the equation for maximizing the information content of a message in analysing sociological systems.

In information theory the information content of a message of n symbols, where each symbol has a probability of occurrence of p_n is:

$$H = \left[p_1 \log p_1 + p_2 \log p_2 + \ldots + p_n \log p_n \right]$$

The condition for maximizing H for a fixed n, is that:

$$p_1 = p_2 = \ldots \ldots = p_n,$$

i.e., the probabilities for each symbol are equal[1].

Although sociological systems are much more complicated than a simple telegraph message the potential analogy was apparently sufficiently significant to the Russians to cause objections to information theory until 1953[2].

According to Dr. Green, the Russians withdrew their opposition to Information Theory in 1953 and since then have allocated substantial effort in this area. They have already developed an alternative proof of one of Shannon's Theorem which is a more rigorous proof.

It appears plausible to me that the Russians have decided that it is more important for them to be pioneers in science and mathematics than to suppress areas of science which might invalidate parts of their philosophy. Perhaps we should utilize the potential sociological analogy of information theory both to support our own democratic ideals and as a criterion in making judgements in our relations with other countires.

In conversations with other engineers at the IRE Symposium in Utica November 6th and 7th I found that there was a general awareness of American engineers of the present intensive work on Information theory in the USSR, but the sensitivity of the Russians to the potential political implication of Information Theory was generally unknown. Therefore, I brought Dr. Green's paper to the attention of many of the engineers with whom I talked.

A Visit to United Nations

On Saturday, November 9th, I visited the United Nations District, New York. It seemed strange to leave the United States to enter a district under the jurisdiction of the United Nations and then walk back into the United States of American without having to go through customs inspection and obtain a passport, etc. I found it thrilling experience to visit the meeting rooms of the General Assembly, Security Council, Trusteeship Council, and Economic Council. The spirit of the growing United Nations made me think that the old League of Nations Association song written by Josephine Daskam Bacon, has more of a real feeling of the future:

Brother, sing your country's anthem
Shout your land's undying fame;
Light the wondrous tale of nations
With your people's golden name.
Tell your father's noble story,
Raise on high your country's sign.

Join, then, in the final glory --
Brother, lift your flag with mine!

Hail the sun of peace, new rising,
Hold the war clouds closer furled.
Blend our banners, O my brother,
In the rainbow of the world!
Red as blood, and blue as heaven,
Wise as age, and proud as youth,
Melt our colors, words woven,
In the great white light of Truth!

Build the road of Peace before us,
Build it wide and deep and long:
Speed the slow and check the eager,
Help the weak and curb the strong,
None shall push aside another,
None shall let another fall:
March beside me, O my brother,
All for one, and one for all!

<div align="right">(Copyright, 1934, by the League of
Nations Association, Inc.)</div>

The Taxi-Driver-Philosopher

On leaving the United Nations District I hailed a taxi cab to go downtown.
The driver was very talkative. A group from some boys military school has
just visited the United Nations. This set off the cab driver on talk about
militarism and the U.N. He asked why do we have to have all this military
preparation; why can't the U. N. move faster in getting all the nations of the
world to cooperate? The cab driver went on to ask why do we have to have
some conflicting religions in the world; why can't people develop a universal
religion out of the best ideas of all the different religions?

Although the cab driver's ideas were over simplified and impractical,
I admire him for communicating his feelsing and strivings for a world in
which all races, nations, and faiths can cooperate in harmony. In a way
he is a spokesman for many people who have a desire for a more stable
economy and wish to see a world free from war, the danger of war.

The Story of Mankind

Saturday afternoon I saw the movie: "The Story of Mankind", which
has some features in common with the book of the same title by Hendrik
Willem Van Loon[3]. It is an inspiring and thought provoking movie about
a hypothetical meeting of the judges of "outer space" sitting in judgement

15C

upon the people of the earth who have invented a super hydrogen bomb which is capable of destroying all life on the earth. The judges are debating whether they should intervene to give man another chance or to let him destroy himself. Counsel for mankind brought an exhibit illustrating the great leaders who have led man to greater heights of civilization. The devil's advocate brought in exhibits from history of man's tyranny and debauchery. I rate "The Story of Mankind: as a very excellent and important movie.

A Second Visit to the United Nations

In my hurry to get to the theater to see "The Story of Mankind" I had taken a brief tour of the United Nations. Since there was some time left before closing time at the U. N. after the movie I raced back to complete my tour at the U. N. and to browse in the bookstore in the basement of the U. N. building.

Artists from different countries of the world have painted murals depicting mankind's striving for peace and international cooperation. The U. N. bookstore was very interesting. There are many U. N. reports for sale on problems of economic stability, world health, technological development, and many other subjects discussed by various U. N. agencies and committees.

Information Theory and Human Information Systems

I found one UNESCO publication particularly interesting: "Information Theory and Human Information Systems" by D. M. MacKay[4]. The paper deals both with amount of information (channel capacity, redundancy, etc.) and with information-flow maps (inverse feed-back systems sometimes classified under cybernetics). The principal paragraph headings as follows indicate the scope of the article.

Introduction	Human Information System
Measuring & Map-making	Stability
Basic Ideas Information-	Remedies for Instability
Some Uses of Measurement	Stability of Social Information
Human Language	Systems
Mechanical Translation	Predictability of Information
Information Retrieval	Systems
Information-Flow Maps	Man as an Information System
A Typical Information-Flow	Freedom and Responsibility
System	Irrelevance of Physical
	Indeterminacy

Implications for Penal Theory.

The author of the above article, Dr. MacKay, formerly worked on radar, then directed research at King's College, London, on problems of high-speed electronic computation, and is now directing a group doing research into the organization of the brain as an information system. The section of predictability of information systems contains a basic theorem:

It is a property of any information system, that a complete predication of it cannot be validly represented by an active part of the system.

The application of information theory to the problem of freedom and responsibility appears highly significant. Dr. MacKay insists that the criterion of human responsibility is not in principle a behavioral but a structural one. The question is basically whether his information system is so organized that our intended description of its future state would be self-nullifying (as a description) if offered to him, because it would be self-referring. The criterion thus reduces in essence to a question of the unity or wholeness of the man's information-flow system.

Reflections On the Occurrence of a Desire for "A World at Peace"

The existence of the United Nations represents an achievement of many individuals who had a striving for a better world like the cab-driver, yet succeeded in expressing their feelings in a more concrete way such that the United Nations finally came into being, and even though weak, is growing into a potential instrument of international cooperation. Do we have to wait for rare occurrences of individuals who have both a striving for a "better world" and the ability to channel their activities along constructive lines to make forward steps in the development of civilization? The thought occurred to me that perhaps studies of child development such as those of the Gesell Institute for Child Development, New Haven, Conn., should shed some light on the probability of occurrence of this feeling or striving for a "better world". I was sure there was something in Gesell's recent book; Youth: The Years from Ten to Sixteen. I searched through the book, following clues in the index and table of contents, but couldn't find the information. I consulted a YMCA secretary who had read the book, but he couldn't recall any useful clues. I had an information retrieval problem. Trying index headings like "ethical sense" yielded a little information but it didn't seem specific enough. It was too late to phone the authors, so I nearly read half the book before I found the material. I finally found the first real clue under "Year Fourteen - Maturity Profile".

".....Albert Schweitzer relates how in his fourteenth year
the joys of seeking for what was true and good came upon
him "like a kind of intoxication". He felt "a passionate need
to think". As a philosopher he holds the 14-year-old youth
in high regard and pays him a compliment. "If all of us
could become what we were at fourteen, what a different
place the world would be!"[5]

Now I am on the right track. However, the above quotation is from
a single great physician-philosopher-musician-missionary and needs to be
verified by statistical data if it is to applied generally. Under "Year Four-
teen - Maturity Traits - The Growing Self"

".....As he voices what he would wish for, Fourteen is
not thinking of himself alone. Rather he is thinking of
himself in the kind of world he would like to live in.
First and foremost he wishes for a world at peace or for
an end of wars. Then he wishes for a better world in
general, in which there is a "unity of nations", "a union
of all religions", and a "high standard of living" and "a
better chance for people to grow up". More specifically
he wishes that there were a more properly run govern-
ment ("one that wouldn't allow taxes to go up!") and a
better educational system......."[6]

The above quotation Gesell implies that this striving for a "unity of
nations" or peace is a general phenomena that occurs during adolescence
in our culture. We may ask on what percentage of the youth studied and
interviewed is the above quotation based? Gesell's study is based upon a
study of 165 different subjects[7]. The above quotation appears to be based
upon extensive interviews supported by questionnaires. An example of a
question given the subject is given below:

Extract from Table 5[8]

Wishes

Question: If you could have three wishes, what would they be?
(Data on wish for "peace" is here extracted from Table 5)

Age	Rank in Order of Most Frequently Occuring Wish	Percentage of Individuals Making Wish for Peace
13	2nd	20%
14	1st	32%
15	3rd	14%
16	3rd	25%

I don't know whether the above table means that at the most 32% of adolescents put a wish for peace in the top three wishes or whether they reach this stage at different times giving a total of 92% of adolescents put a wish for peace within their top three wishes at some time in the 13 to 16 year range. At least we can say that Gesell's data give a correlation factor of at least 32% in support of Albert Schweitzer's statement.

The Cab-Driver's Wish Grows in Reality

Our cab-driver of age 40 still expresses his wishes of age 14 for a "unity of nations", "a union of all religions", and a "high standard of living" and "a better chance for people to grow up". At first I felt sad that the cab-driver had not succeeded in becoming a great leader in politics, in education, or in religion. But in reality he is performing an important function like the "keep-alive" electrode in a radar TR-tube. He, through his talking, may be reminding many travelers of their ideals which got pushed aside in the rush of business.

Sunday morning I attended services of The Community Church of New York. I was pleasantly surprised to find it a truly inter-racial church. Here was a group of people doing pioneering work of developing ways in which people of different racial and religious background can cooperate in a common church. The purpose of the Community Church as stated in its news bulletin is:

"This Church is an institution of religion dedicated to the service of humanity. Seeking truth in freedom, it strives to apply it in love for the cultivation of character, the fostering of fellowship in work and worship and the establishment of a righteous social order which shall bring abundant life to men. Knowing not sect, class, nation, or race, it welcomes each to the service of all".

This type of a Community Church is very important in providing a place where pioneers can work on the frontiers of problems of the cooperation of diverse human groups. I do not advocate any departure from the principle of separation of church and state.

As the complexity of our civilization increases the principle of separation of church and state may have to be reformulated in different terms. In an agricultural community the rights of the individual to religious freedom can be guaranteed by constitutional provisions prohibiting legislation establishing "an official religion". As large cities and a more general public school system the problem of separation of church and state become more closely related to the prohibition of the use of public tax funds to support particular religious groups. The advent of the more extensive use of the power of eminent domain by the state in expanding schools and universities, building freeways, and redeveloping depressed areas of our large cities raises questions as to how the principle of "freedom of religion"

can best be safe guarded under these new conditions. A redevelopment board may be assisting or retarding particular religions through its decisions in planning redevelopment projects. Perhaps a new criterion for assuring freedom of religion can be developed, based upon the maximizing of information in our society.

Science and Social Responsibility

I have long been interested in the problem of how much social responsibility should a scientist assume for the application of his work. Organizations like the Society for Social Responsibility in Science have brought scientists together who have concern for the use of science for constructive purposes. In an authoritarian society a scientist who does not want his work used for destructive purposes has a negative action available to him of refusing to work on projects he does not approve. In a democratic society the scientist has a greater range of possible action. In addition to the negative action he has a positive action available to him, namely the opportunity to explain the significance of current scientific research to the laymen in order to give the laymen the knowledge needed to vote intelligently on important issues.

I agreed to speak Sunday evening to the S.S.R.S. chapter in Philadelphia meeting at the University of Pennsylvania. I found the meeting very worthwhile to get other people's reactions to my ideas. I used a film-strip on the "Lost Symbols"[9] to illustrate how specialists in a prior age found ways to explain their specialized knowledge and insights to the layman. During the middle ages only a small percentage of the people could read and write. The priests developed art forms such as stained glass windows and carvings to illustrate their sermons in a way that conveyed meaning to people who couldn't read. In many of the old cathedrals each section of a stained glass window represented a sermon. Many of the symbols were described in the "Bestiary" which was a book "natural science" and moral and religious teachings. For example, the sly fox was used to indicate how wary we must be of falling into temptation. The dove was used to illustrate the sermon theme: Christians are to be harmless as doves, hurting no one by word or deed. The scientific information (or nature study) contained in these examples was faulty. As man learned more about nature these symbols were discarded. During the period of use of these symbols, they helped emphasize the central ideas of the sermons and acted as reminders to the laymen of the principles given in past sermons.

Why cannot the scientist of today work with artists to develop art forms to illustrate the important points of modern science? The lost symbols are not adequate for today's problems, but they inspire us to contemplate the possibilities of the future. When a specialist such as a scientist is concerned about the application of his work, he assumes a positive responsibility in a democracy of developing ways to explain the significance of his

work to the layman.

The role of the scientist changes from solely that of a searcher for the truth to a role implying in addition a responsibility to explain his work to the layman as we enter a new state of the biosphere, namely the "noosphere"[10]. The name for this new epoch was coined by W. I. Vernadsky of the Academy of Sciences of the U.S.S.R. from the Greek word "noös" meaning mind, to represent the epoch where man through his intellectual activities is able to make geologically significant changes in the "biosphere", i.e., in the portion of the earth's crust surface, and atmosphere where life can exist.

As we pass into this new epoch of the geological history of the earth — the Noosphere, man needs a new perspective to symbolize the fact of man's importance, now he has the power and responsibility to make geologically significant charges on the Earth. What will be the symbols of the new era that will link the myths man believes with the great creative potentialities of this new epoch? Will the symbol of the era be an Elvis Presley, a Davy Crockett, or an Albert Schweitzer? Or will some new symbols of man's knowledge of himself and of nature be created? To open up discussion of these potential symbols I presented a series of slides illustrating potential symbols such as the logarithmic increase curve common to many phenomena, symbols representing cybernetics and information theory, great heros, technological turning points, theoretical developments such as Einstein's special theory of relativity, and the golden plover -- a bird whose navigational ability is not yet understood by science; but which intrigues the mystics.

I feel that decisions as to what is a constructive use of science involve a more complicated analysis than a simple division of projects in military and non-military work. An example of a very significant contribution to basic research supported by military contracts is the work summarized in Essays in the use of Information Theory in Biology[11] edited by Henry Quastler.

National Security and Cybernetics

The system of loyalty oaths and security checks covering most governmental jobs needs to be reviewed as to its validity. It seems logical that there are sensitive positions in the Department of Defence, State Department, and other government agencies where specific information must be safeguarded by such security checks. However, it appears that the use of security checks for all government employees and large sections of engineering and manufacturing has (a) disabled the feedback loop system in our society which is needed to make our social system stable and (b) disabled part of the creative ability of our young people through the

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atmosphere inhibiting expression of their normal feelings for peace and a better social order which develops during adolescence. Great leaders like Wendell Wilkie had opportunities to sample the politically radical groups that existed in our country during his youth in a way to develop understanding of the economic and political problems of our country

·The prosecution of communist party leaders under the Smith Act may have been a particularly disastrous occurrence for our country. Radical or dissenting political groups are needed in a democracy to provide the feedback loops which act as thermometers to indicate (1) where there are injustices in our social system, and (2) the incidence of psychologically immature people in our society. It may be difficult to determine how much radical political activity is due to inadequacies of the social system and how much is due to psychologically unbalanced people.

The present situation requires that individuals take the responsibility on their own initiative to understand what is going on in our society -- to find out what philosophical ideas are generated by the conditions in our society and what types of psychological problems are accentuated under present conditions Individuals who seek to understand the problems of our society in a way that re-establishes the necessary feedback loops for stability in our country, have to develop principles like a physician who holds in confidence the problems of his patients The person who seeks to help stabilize our country must keep in confidence the names of people he interviews, if he is to be free to use their political ideas in analysing our society.

This whole problem of national security and the stability of our nation could probably be reformulated now through the use of Decision Theory[12]. Although we do not have accurate information on the loss matrices for loss of military information through spying and loss matrices for the loss to our society from the crippling of feedback loops, a mathe matical model can help direct our research on such problems.

Conclusions

The interchange of ideas between social scientists, political leaders, citizens, engineers, and mathematicians can result in refreshing re-examination of important problems in our society. The layman may have the keenest sense of what the problems are, but may confuse the issue by oversimplification. The social scientists have the detailed knowledge, but need the mathematical and analogical assistance from mathematicians and engineers. This type of work can be done as a hobby by the people concerned during the exploratory stages of developing a greater interchange of ideas across the boundaries of established disciplines

F. B. Wood
12 - 13 - 57

Problem 5.1: How can engineers and physicists communicate their
feelings for a need of understanding the evolution of
civiltation (to the appropriate social scientists and
humanists) so that there can be creative cooperation?

(a) They can write letters to individuals.

(b) They can write to the editors of a few specialized journals.

(c) They can try to find interested social scientists in
nearby colleges who either are interested in these
problems or need assistance in the use of engineering
concepts in their own research.

(d) They can find national organizations which are interested
in specific aspects of the problems such as:

> Federation of American Scientists
> Society for General Systems Research
> Social for Social Responsibility in Science

Problem 5.2: How can the challenge of the Russian technological
competition be used to ask more important questions as to
mankind's ethical goals?

Problem 5.3: Can information theory which gives higher value
(negetive entropy) to rare events (individual creative
ideas) be used to help formulate theories of the balance
between organization (control) and freedom (individual
creativity)?

Problem 5.4: How can we develop a symbolic way of showing what
progress has been made by the United Nations and individual
nations in partial solution of national and international
problems? Can information theory be used to allocate space
to different groups in an exhibit of social progress?

Problem 5.5: How can we gain more public understanding of the
potential link between two classes of phenomena pointed out
by Warren Weaver, namely: physical measurable entities such
as weight, length, electric field strength;, and intuitive
or emotional entities such as beauty, love, and melody?

Problem 5.6: How can our society help scientists and humanists
develop integrated personalities, so that they can develop
their truly human qualities at the same time they specialize
in narrow sections of knowledge?

Problem 5.7: How can our society become more responsive to the
simple needs of the taxi-driver, the carpenter, the painter,
the housewife, the poet, the mathematician, etc., so that
our research institutes give moreserious attention to the
needs of mankind that can be discovered by direct contact
with people, but which get filtered out by the political
and economic decision-making organizations in our society?

Problem 5.8: How can the artist, musician, and poet be informed
     of the great potential inherent in science through information
     theory, cybernetics, and decision theory, so that they may
     help interpret the needs of the people and the dreams of the
     scientist?

Problem 5.9: How can we develop ways to let our teenage youth
     conceive and carry out their ideas of a "better world"
     through practical projects instead of feeling that they must
     forget the high ideals they learned in Church Sunday Schools?

Problem 5.10: How can we develop an information retrieval system
     to help isolated scientists and scholars exchange ideas that
     might help in the solution of the problems of our civilization?

Problem 5.11: How can we protect individual freedom in general
     in an era where massive organizations, either state or
     corporate dominate many areas of human activity?

Problem 5.12: How can we use cybernetics to simulate a model
     of significant components of our society to see if loyalty
     oaths and extensive security investigations disable important
     feedback loops needed to keep our society functioning in
     a creative but stable manner?

Problem 5.13: How can we evaluate the possible psychological
     damage to many potentially creative individuals through
     the social atmosphere of inhibiting their normal feelings
     for peace and a better social order?

π.   Eugen Rosenstock-Huessy Out of Revolution (1938), pp. 741, 753

SOME THOUGHTS FROM ROSENSTOCK-HUESSY[π]
                         On the stages of Western Civilization- - -
credo ut intelligam (Anslem)

               Truth is divine and has been divinely
               revealed

cogito ergo sum (Descartes)

               Truth is pure and can be scientifically
               represented

respondeo etsi mutabor (Rosenstock-Huessy)

               Truth is vital and must be socially
               represented

     . . . . However, finally
          credo ut intelligan
                    led to
                         the Inquisition,   and
          cogito ergo sum
                    into
                         an ammunition factory.

References

1. C. E. Shannon "A Mathematical Theory of Communication" Bell Telephone Laboratories. Monograph B-1598 (B.S.T.J. Vol 27. pp. 379-423. 623-656. July, October, 1948); See Theorem 2 and Fig. 7 on pp. 15-17 of Monograph B-1598 This material can also be found on pp 18 - 22 of Claude E Shannon Warren Weaver The Mathematical Theory of Communication, Urbana, Ill: Univ of Illinois (1949) A less technical description "Information Theory" by Weaver is included

Another example of the maximizing of the information as a function of the probability distribution is given in Fig 2 of "Round Table Discussions on Behavior Theory" Behavioral Science. Vol 1, No 1, pp. 69 - 78, (January, 1956)

2. P E. Green, Jr "Information Theory in the U.S.S.R." pp 67 - 83, IRE-WESCON Convention Record. Part 2, August. 1957

3. Hendrik Willem Van Loon, The Story of Mankind, N Y Liveright (1921); Revised edition, N Y Pocketbooks (1939)

4. D. M. MacKay "Information Theory and Human Information Systems" Impact of Science on Society, Vol VIII (1957) No. 2, pp. 86 - 101

5. Arnold Gesell, Francis L. Ilg, and Louise Bates Ames Youth - The Years from Ten to Sixteen, N Y. Harper and Brothers (1956), pp 181 - 182

6. Op. Cit p 195

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10. W. I. Vernadsky "The Biosphere and the Noösphere" American Scientist 33:1 p. 10-, January 1945

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16C

ALBERT SCHWEITZER ON "REVERENCE FOR LIFE"

The following quotations from Albert Schweitzer are of interest to
me in looking into the future potentialities of information theory
in guiding mankind's search for a fuller and more ethical life.

I Live for Other Life [1]

Ethics is nothing else than reverence for life.   Reverence
for life affords me my fundamental principle of morality, namely,
that good consists in maintaining, assisting and enhancing
life, and that to destroy, to harm or to hinder life is evil.
Affirmation of the world, that is to say, affirmation of the
will-to-live which appears in phenomenal form all around me , is
only possible for me in that I give myself out for other life.
Without understanding the meaning of the world I act from an inner
necessity of my being so as to create values and to live ethically,
in the world and exerting influence on it.   For in world- and life-
affirmation and in ethics I fulfil the will of the universal
will-to-live which reveals itself in me.   I live my life in God, in
the mysterious ethical divine personality which I cannot discover
in the world, but only experience in myself as a mysterious
impulse. (Ethics, p. xvi)

The Driving Force of the Ethical [1]

Thought must strive to find a formula for the essential nature of
the ethical.   In so doing it is led to characterize ethics as self-
devotion for the sake of life, motivated by reverence for life.
Although the phrase "reverence for life" may perhaps sound a trifle
unreal, yet that which it denotes is something which never lets
go its hold of the man in whose thought it has once found a place.
Sympathy, love, and, in general, all enthusiastic feeling of real
value are summed up in it.   It works with restless vitality on the
mental nature in which it has found a footing and flings this
into the restless activity of a responsibility which never ceases
and stops nowhere.   Reverence for life drives a man on as the
whirling, thrashing screw forces a ship through the water.
(Ethics, p. 256)

1.   Charles R. Joy, editor.   Albert Schweitzer - An Anthology
Boston: The Beacon Press (1947), pp. 259-261.

DISCUSSION OF SOME COMMENTS OF J. D. BERNAL AT THE INTERNATIONAL
CONFERENCE ON SCIENTIFIC INFORMATION, WASHINGTON, D.C., NOV 16-21,
1958. (Preprints, Area I, pp. 67-85.)

Professor J. D. Bernal presented a paper "The Transmission of
Scientific Information: A User's Anlysis." He states "...it is
legitimate to ask not only how the information is to be dealt
with, but also what that information is, who is it intended for,
and to what degree does the process of transmission of information
help in the advancement of science."" (p. 65)
"Information, even vitally needed information, takes months or
years to reach those most in need of it." ......"The basic fact
remains, the amount to be read increases exponentially, and the
time anyone has for reading it remains the same. Therefore a smaller
proportion of what is written is read by any one person."

"one escape from this is through increasing specialization. Reading
surveys show that one scientist can keep up with the work of some
two hundred others in active production, but a field which contains
only two hundred workers is necessarily a very narrow one......
Here what science losses by such enforced specialization is the
cross fertolization of ideas from different fields such as lead
to all great discoveries."

"The average scientific author of today - - I am not talking of
men of established reputation or easily recognized young geniuses
- - has less chance of having his work understood and made use
of than at any previous period in the history of science."(p. 77)

........"To use a biological simile, the method of transmission
of scientific information is on the most primitive level of wind-
blown pollen. ....We ought to advance at least to the more
selective stage of insect-borne pollenation where with far less
pollen more gets to the right flowers. What we need now is to
return to scientific communication on a vastly greater numerical
scale and to make use of complex organization and mechanisms in
place of inefficient dissemination."

Professor Bernal goes on to discuss the possibility of some
information center which would receive original papers and
distribute abstracts and make microfilm or other copies
available to those who want the the original (complete) paper.
"I still feel , for reasons already given, that instead of the
present intermediate length paper of ten to twenty pages, it
would be better to have a short printed paper of some two pages
of what has been called an informative abstract. This would be
supplemented by a longer, more detailed paper, not printed and
published, but available in duplicated, microfilm, or other
modern method of reproduction, to all those thought to be in-
terested in it or who requested it." (pp. 79-80)

I suggest that Dr. Bernal's concept of an information center is
what is really needed to handle the problem of communication
between engineers, mathematicians, and social scientists. Such
a center could prevent any real duplications of the type to which
Dr. Elias objects to. In the meantime I shall establish the best
channels I can by personal letter, contacts through the Society
for General Systems Research, and by depositing copies of working
paper drafts like this with the National Science Foundation.

July 3, 1959   Frederick B. Wood

"Some Comments Deleted From The Original Issue of SEP 5"

As a test of this need for communication with a specialized
audience rather than publication, I conducted an experiment in
communication.   Since I did this as a hobby, I mimeographed at my
own expense one hundred copies of Socio-Engineering Problems No. 1
containing an earlier version of my paper on the "Social
Responsibility of Engineers" which included material on Problems
1.1, 1.2, and 1.3 which are restated on page ii of this issue.

Out of the one hundred copies distributed to various engineers,
scientists, and religious leaders, I received thirty-eight replies.
Most of the replies were favorable.   Many included constructive
criticism, pointing out material on the subject which I had not
found.   A few replied with sarcastic criticism, and one copy came
back with no comments or identification of who returned it.
I hope to be able to acknowledge the valuable suggestions people
have sent me by including a note at the end of this or some future
issue.

This project of advancing the study of socio-engineering problems
is something I take full responsibility for myself.   I do so in
order to live up to my responsibilities as a registered professional
engineer in the State of California and as a member of the National
Society of Professional Engineers.   These statements in this series
do not represent any policy of my employer.   When editing material
from this series for use at an engineering society technical
convention, I comply with all the precautions implied in the Code of
Ethics and Policies of the N.S.P.E. to protect the interests of my
employer.   For example when invited to talk at a computer conference
I review my proposed speech with my employer to make certain that
I am not discussing material which would jeopordize the proprietary
interests of my employer or would lead to confusion with company
policy.

For this issue the challenge of Dr. Elias' criticism of the first class
of papers prompts me to revive an old manuscript of mine on "The United
Nations, Information Theory, Cybernetics, and Decision Theory."

                              Frederick B. Wood
                              June 6, 1959

"Notes on Talk of Sunday , Nov. 10th, 1957
In Philadelphia and Supplementary Notes."

Outline of Talk of 11/10/57:

"Social Responsibility and Information Theory."

1. The scientist gives some thought about the social application

    of his work, but ......ususally concludes that the direct social

    application of work is statistically small, i.e., in a way that

    can be directly and immediately traced.

    The development of information theory in the last ten

    years provides a basis for:

    a. Awakening more scientists to their social

        responsibility.

    b. Explianing to the layman(who elect the people

        who make national policy decisions) what science is.

2. What is Information Theory?

$$H = -\sum p_i \log p_i$$

    a. Technical

    b. Semantic

    c. Affective

3. History.

    N. Wiener

    C. Shannon

    Warren Weaver

    Brillouin

    Giforov

4. Historical Relationship between Science and Religion.

          a. Filmstrip: Lost Symbols.

          b.   Destroyed Symbols.

          c. Freud: Psychoanalysis.

5. What will be the symbols of the Future?

     Slides:

        Ideas: Philosophy and Science

        Leaders......

        Music.........

```
4                              ......core of slides from SEP 3
5
6
7
X..... log-log chart (group therapy)
....Noosphere
10  ⎫
11  ⎬ Cybernetics
12  ⎪
13  ....⎬. p(x)  USSR
14  ⎭

15
16
17
18
sputnik
19
20
X
XX      ..... 3 levels
9       ..... include p(x) IT in USSR
```

6. Information Theory Example

     Relationship with Thermodynamics

     Information === Negentropy

     "Reverence for Life"

7. Use of the natural sense of social responsibility that every human being normally has in adolescence, instead of educating to conformity.

Supplementary notes from thoughts of 11-9-57:

1. Social responsibility in science requires a much broader responsibility than for one's individual acts. The application of science to civil and military projects involves decisions which set examples that will the prototypes for many other decisions.

2. Consideration of how people function is important. In a democracy the people must vote on representatives who will in turn decide on government science policy. The public and the representatives mus have some understanding of science....

3. The natural feeling of social responsibility that comes in adolescence in our society must be accepted and developed instead of being suppressed. Quaker work camps help develop these natural tendences to evolve into constructive skills and attitudes.

4. Information Theory and Ethics.

   a. The use of Information Theory will help us establish a scientific base for ethics (of religion) formerly based on "God"-given commandments.

   b. This is related to Freud's "Future of an Illusion."

5. The role of the organization and aplication of our sex drives is very important in the succesful completion of creative activities. For example dreams about Sheena-X(Feminine counterpart of Tarzan in the TV-Movies) are significant in structuring creative activity. Sex is important in creative activity from a variety of aspects ranging from allocation of brain and central nervous system memory and control functions to the problem to clearing test voltages left over from a completed phase of the problem to be able to attack the next phase.

Date: 11/9/57   11/10/57   12/13/57   6/6/59   3/18/67
Stage: Notes   Lecture   Report   SEP 5   File 5-B