SOCIO-ENGINEERING PROBLEMS REPORT No. 91

Socio-Engineering Problems Reports are a series of manuscripts on the social relations of engineering and related philosophical questions dealing with the interaction of science and society. Distribution is limited to reviewers and discussion groups for criticism prior to consideration for possible publication.

FOUR PHILOSOPHICAL "TOOLS" FOR IMPROVING OUR INSIGHTS REGARDING THE PROBLEMS OF DISARMAMENT.

See SEPR No. 92-B for further developments.

Abstract

Some hypotheses are proposed and discussed relevant to four philosophical "tools" of potential value in developing better insights regarding the problems of disarmament, namely:

(1) A pseudo-Gaussian probability curve form of historical and future perspective for extending the concept of the Histomap;

(2) A three-dimensional checking chart based on levels of natural phenomena / ranges of activity from basic science to applied science to education to decision making / and range of method from religious-intuitive to humanistic-poetic to scientific-logical;

(3) A discrete channel partial model of a social system using the information-entropy metaphor to obtain a quantitative measure of the democracy in a social sub-system; and

(4) A continous channnel model of a social system for obtaining qualitative measure of a concept of "dynamic-justice" in social-political sub-systems.

The above philosophical "tools" are proposed for helping us put the present problems of our civilization in suitable perspective in regard to the rise and fall of previous civilizations on our planet, the rapid development of science, new features of the present situation which make these crises at the beginning of the noosphere different from past crises, etc. The concept of "dynamic-justice" is developed in an attempt to gain some depth of insight into the role of political idea distributions in determining the feasibility of disarmament efforts.

Note: 'Tool' (4) is an extension of the concepts discussed in SEPR No. 88-B, "Negentropy and the Concepts of Freedom, Deomocracy and Justice."

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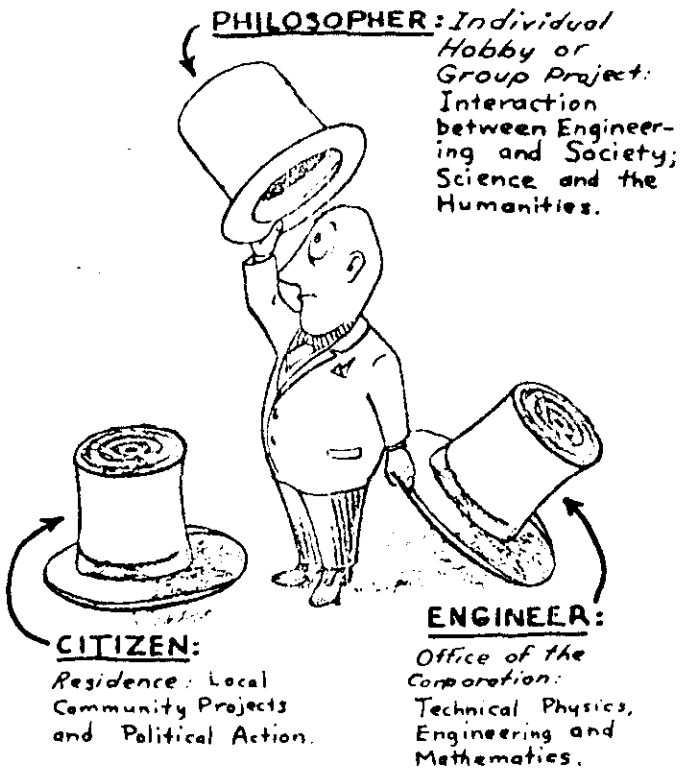
Four Philosophical Tools for Improving Our Insights Regarding the Disarmament Problem

I. Introduction.

This paper is a progress report on the development of some philosophical tools which I think will be useful in gaining insights into the problems of disarmament. These tools are directed toward developing some perspective as to where we are in the evolution of human civilization and to give some clues as to whether the conflicting powers are at stages compatible with disarmament efforts. There have been times such as during World War II when it was obvious that it was the wrong time for disarmament efforts. These "tools" are aimed at finding a quantitative measure of the degree of democracy attained or stage of evolution a country has reached, and a qualititive measure of its present capabilities of advancing to a higher level of development. The method used in this study is to extend the "information entropy metaphor" by hypothesis and test the results for compatibility with known facts. To develop a suitable perspective in time an "earth civilization log time scale" is developed by analogy from a Gaussian probability distribution. The classification schemes of the founders of Sociology - Comte, Spencer, and Ward - are extended to develop a perspective in regard to the three dimensions of phenomena, types of study(humanistic-poetic to scientific-logical), stages of development(basic science, applied, education, and decision making).

The philosophical ideas presented here have been developed by me as a hobby on a project I call "Socio-Engineering Problems." The object of this arrangement is to clearly separate my indepenoent philosophical studies from my engineering work. To illustrate this more clearly let us examine Slide 1.



Slide 1. An Engineer Changes Hats to Symbolize His Three Different Roles and His Attempt to Correctly Identify in What Role He Is at a Given Time.

As shown in Slide I, I issue technical engineering reports through the publication department of the corporation for which I work. Philosophical studies are issued through Socio-Engineering Problems without review by the corporation, letters or statements containing political or religious views are issued from my residence address.

Some of the ideas in this report occured in embryonic form while working in the M.I.T. Radiation Laboratory during World War II, while others developed as byproducts of my later work in computer-communication systems. I can recall that in 1946 I found a book by F.S.C. Northrup, The Meeting of East and West,(1) in which the need for a philosophical approach was more eloquently stated than in my own notes:

> "The time has come when these ideological conflicts must be faced and if possible resolved. Otherwise, the social policies, moral ideas and religious aspirations of men, because of their incompatibility one with another, will continue to generate misunderstanding and war instead of mutual understanding and peace.
>
> It is hardly likely that these sources of conflict can be faced and removed in practice within the halls of parliaments and the heated actions of the market place, where slogans are bandied about, special intersets are at work, and passions are easily aroused, unless the problems raised are first traced to their roots and then resolved in theory within the calmness of the study where the meaning of words like "democracy" and "communism" can be darefully determined and the issues which they define can be looked at more objectively.. ....." (pp.ix-x)

Dr. Northrup in his 500-page book did an admirable job of describing the different ideological backgrounds of the different parts of the world plus considerable detail on the different approaches to life in both the East and theWest. However, I feel that few politicians, managers, and decision makers have take time to study carefully books like the one produced by Dr. Northrup. This observation led me to deduce that we need some philosophical "tools" that can help people gain an insight into the total perspective of world civilization so that they can at least call in the best panel of experts on a given problem.

(1) Ref, F. S. C. Northrup, The Meeting of East and West. N.Y.: Macmillan (1946)

(3) (Histomap of Religions; Histomap of Civilization) Rand- McNally, Chicago //John B. Sparks, The Histomap of History.(1952)

(4) G. Gamow, The Biography of the Earth N.Y.: Viking Press(1941)

Perhaps we need something like Dr. Gannett's "Wicket Gate to the Bible"[2] which was a litt e pamphlet prepared at the turn of the century which included diagrams and general descriptions of the state of our understanding of what light recent anthropoligical and linguistic studies shed upon the writing/the books of the Bible. Some components of human history are displayed in a convenient form in the Histomap[3] series. George Gamov in The Biography of the Earth[4] developed some charts showing more of the physical events in the development of the earth and projected future physical events such as future ice ages. It is desirable that some unified means be developed to represent all past and projected future events on the same scale.

A second type of perspective chart needed is one that helps us determine how well we have covered the different approaches that might be relevant to a probelm such as disarmament. There appear to be three dimensions of particualr significance, namely types of phenomena; stages of activity from basic science to decision making; and a range of method from humanistic-intuitive to scientific-logical.

A third tool needed to help us gain perspective of the problems of our civilization is a measure of what stage of social development a country is at (or possibly a measure of the degree to which it has become democratic).

A fourth tool needed due to the third concept being static is some measure of what we might call "dynamic-justice" or the ability of the social structure to maintain the gains already made while evolving to a higher stage of development without having to go through a destructive revolution or retreat backwards.

(2) W. C. Gannett, A Wickett-Gate To The Bible, Boston: American Unitarian Association(1907), 35pp, includes charts: "Growth of the Hebrew Religion and the Bible, and The Bible Book-Case as arranged by higher criticism."

II. Construction and Testing of Hypotheses.

First we must inquire how the scientist decides to accept a particular hypothesis like the Einstein Special Theory of Relativity. In many fields of science we never have absolute proof of a law, but have to be satisfied with testing hypotheses and using the hypothesis which is most consistent with the known facts. Maxwell's equations haven't been derived from more fundamental laws, without assuming one relationship that comes from knowing Maxwell's equations. The special theory of relativity is an interesting example. It is one of seven competing theories listed in Fig. 2 which is based on Panofsky's lectures(5). If one examines the status of agreement of disagreement of each theory with the thirteen experiments, one can easily see that Einstein's special theory of relativity is the only one of the theories that has no contradictions. Therefore scientists accept the special theory of relativity until someone finds some experiment which results in a contradiction. Professor Panofsky considers the validity of the special theory of relativity as follows:

> "This outline(Fig. 2) of the experimental basis shows that experiment contradicts any reasonable alternative to the theory of relativity, rather than any single experiment proving the theory. The experiments outlined above(Fig. 2 on next page) present evidence that:
> (1) The presence of an ether, either stationary or convectively carried, cannot be established.
> (2) Modification of electrodynamics of the emission theory type is untenable. The conclusions then make it plausible to look upon the basic laws of mechanics as in need of modification.
>
> In 1905 Einstein proposed as a solution, compatible with the experimental facts known at that time, the following postulates:
> (1) All laws of electrodynamics (including, of course propagation of light with the velocity c in free space) shall be the same in all inertial frames, as are the laws of mechanics.
> (2) It shall be impossible to devise any experiment defining a state of absolute motion or to determine a preferred inertial frame having special properties for any physical phenomena.
>
> It is clear that if the laws of physics obeyed these postulates all the experimental facts outlined above (Fig. 2) would be in agreement with these postulates." (5)

(5). W. K. H. Panofsky, Classical Electricity and Magnetism, Physics 210B, Univ. of Calif. Syllabus UG, Mar 1949, pp. 249-251.

p 4A.

EXPERIMENTAL EVIDENCE OF THE SPECIAL THEORY OF RELATIVITY[1]

	Theory \ Experiments	Aberration	Fizeau Experiment	Michelson-Morley	Trouton-Noble	Kennedy-Thorndike	Moving sources and mirrors	Positive Ray and Binaries	Michelson-Gale-Pearson	Variation of Mass with Velocity	General mass-energy equivalence	Inductor Induction with permanent magnet	Radiation from moving charges, i.e. cathode ray, X-rays, etc.	Meson decay at High Velocity
Ether Theories	Stationary ether, no contraction	✓	✓	N	N	N	✓	✓	N	N	O	N	✓	O
	Lorentz contr. stationary ether	✓	✓	✓	✓	N	✓	✓	✓	✓	O	✓	✓	O
	ether attached to ponderable bodies	N	N	✓	✓	✓	✓	✓	✓	N	O	O	O	O
Emission Theories	Original source	✓	✓	✓	✓	✓	✓	N	N	O	O	O	✓	O
	Ballistic	N	N	✓	✓	✓	N	N	✓	O	O	O	N	O
	New Source	N	N	✓	✓	✓	N	N	✓	O	O	O	N	O
Special Theory of Relativity		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓ = agrees N = contradiction O = does not apply

Slide 2. Experimental Evidence for the Special Theory of Relativity.

The philosophical "tools" of this report are presented as working hypotheses which may take some years to test. I feel that the problems of survival of our civilization are important enough to risk premature discussion of hypotheses which have not been thoroughly tested in order to make the ideas available to other people who may be better prepared to test the hypotheses than I. For a more recent series of papers on hypotheses in science, I refer you to some work of Professor Gerald Holton.(6)

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6. Gerald Holton, "Thematic and Phenomenic Hypotheses: Concepts for Re-evaluating Historic Stages in Physical Science," paper delivered at 10th International Congress for the History of Science, Cornell, Aug. 30, 1962. (See also similar paper at A.A.A.S. Meeting, Philadelphia, Dec 1962)

III. Four Hypotheses for Use in Developing a Better Perspective of the Problems of Disarmament.

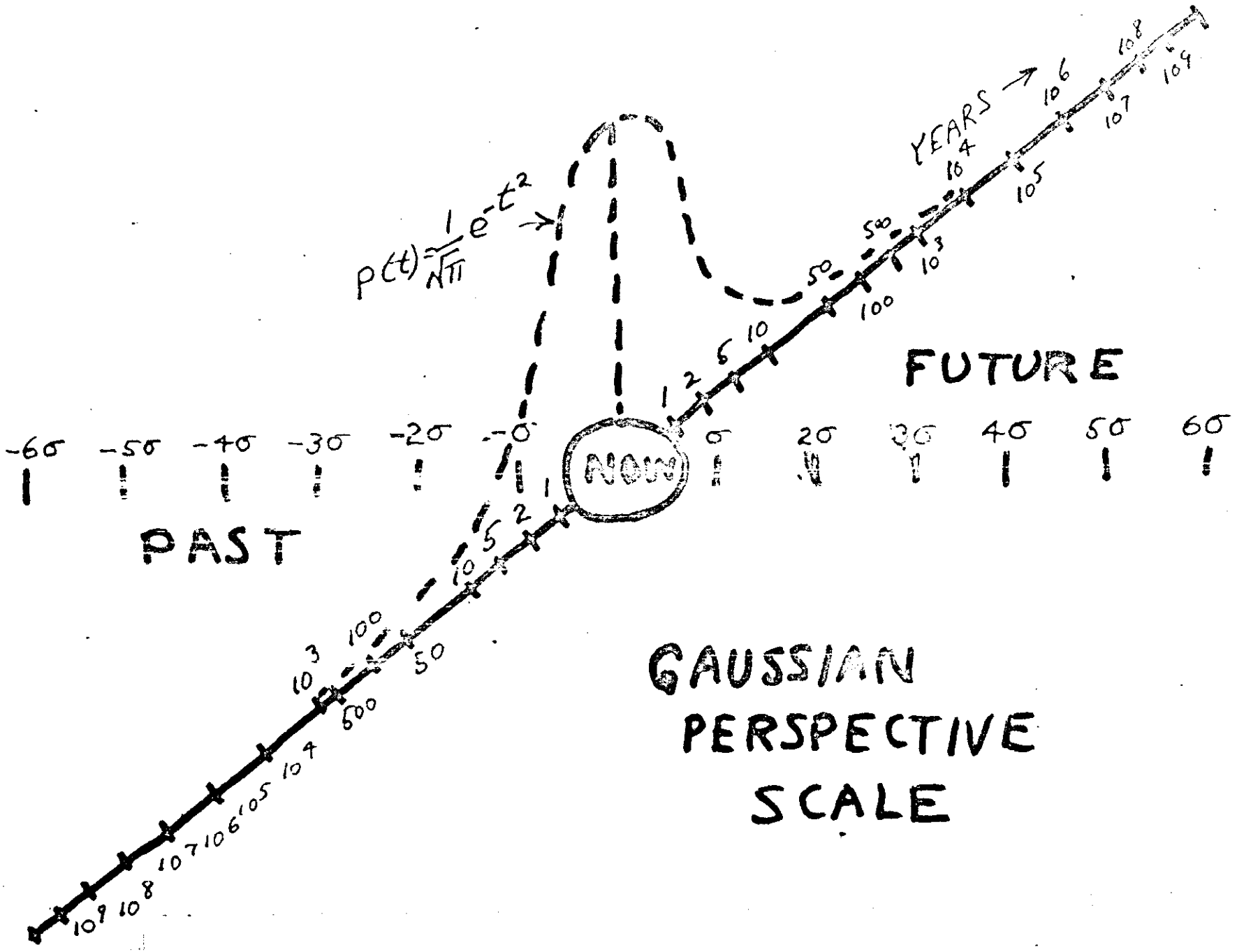
These four philosophical "tools" are presented as hypotheses for use in developing a better understanding of the potential paths that may be possible for arms control and disarmament.

A. A Gaussian Perspective Scale.

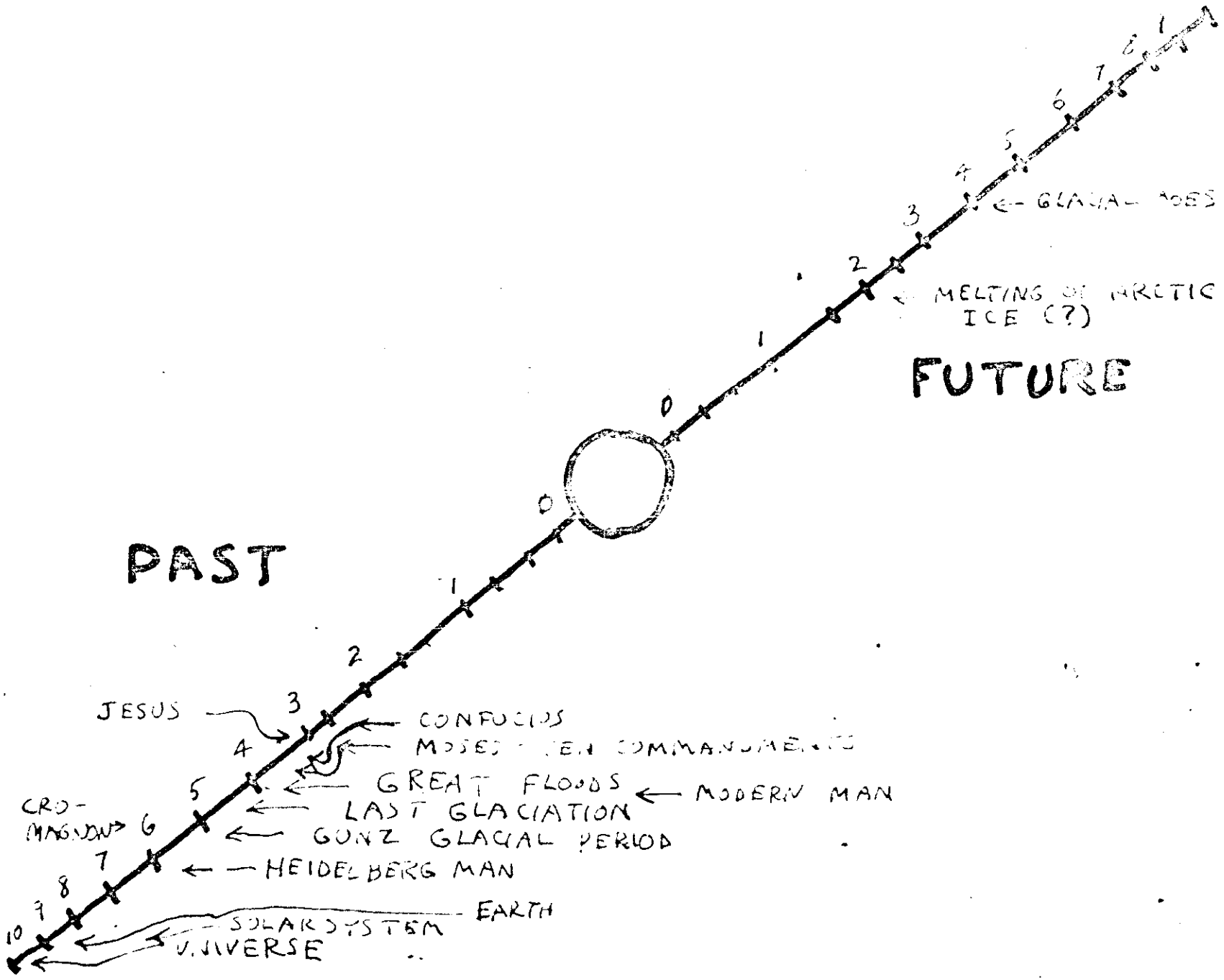
Slide 3 shows a Gaussian perspective scale covering a range of from minus 10^{10} years to plus 10^{10} years, which is sufficient to cover the longest time estimate of the age of the universe and the longest estimate of the future span of our solar system. This scale is similar to the probability paper on which gaussian probability integrals become straight lines. [A more precise definition will be inserted later, but before the formal presentation if accepted.] This type of scale combines two features: (1) the Histomap logarithmic scale for long time intervals, and (2) the inclusion of both the past and the future as is done in some of Dr. Gamov's charts.

Slide 4 shows the principal physical events in the history of our planet plus three of the great religious prophets. The inclusion of potential future problems such as the next melting of the arctic ice and the following glacial ages are useful to remind us that there can be deeper physical crises like the past glacial ages occuring again in the future. The numbers on this slide are logarithm to the base ten of the years.

Slide 5 shows the major stages in the development of mankind's mental abilities.



Slide 3. A Gaussian Perspective Scale.



Slide 4. Physical Events and Principal Religious Prophets on Gaussian Perspective Scale.

The principal stages on Slide 2 fall roughly near multiples of a standard deviation in earth-civilization-log-time*.

[* This needs to be defined more precisely]

These steps are summarized roughly as follows:

Number of Standard Deviations	Stage of Development
Minus one	Intelligence amplifier potentials of simulation of complex problems on computers became realisable.
Minus two	Organized scientific research became established.
Minus three	Superverbal abstractions of mathematics and the scientific method established.
Minus four	Man developed verbal communication.
Minus five	Pre-modern man developed subverbal communication.
Minus six	Beginning of our solar system.

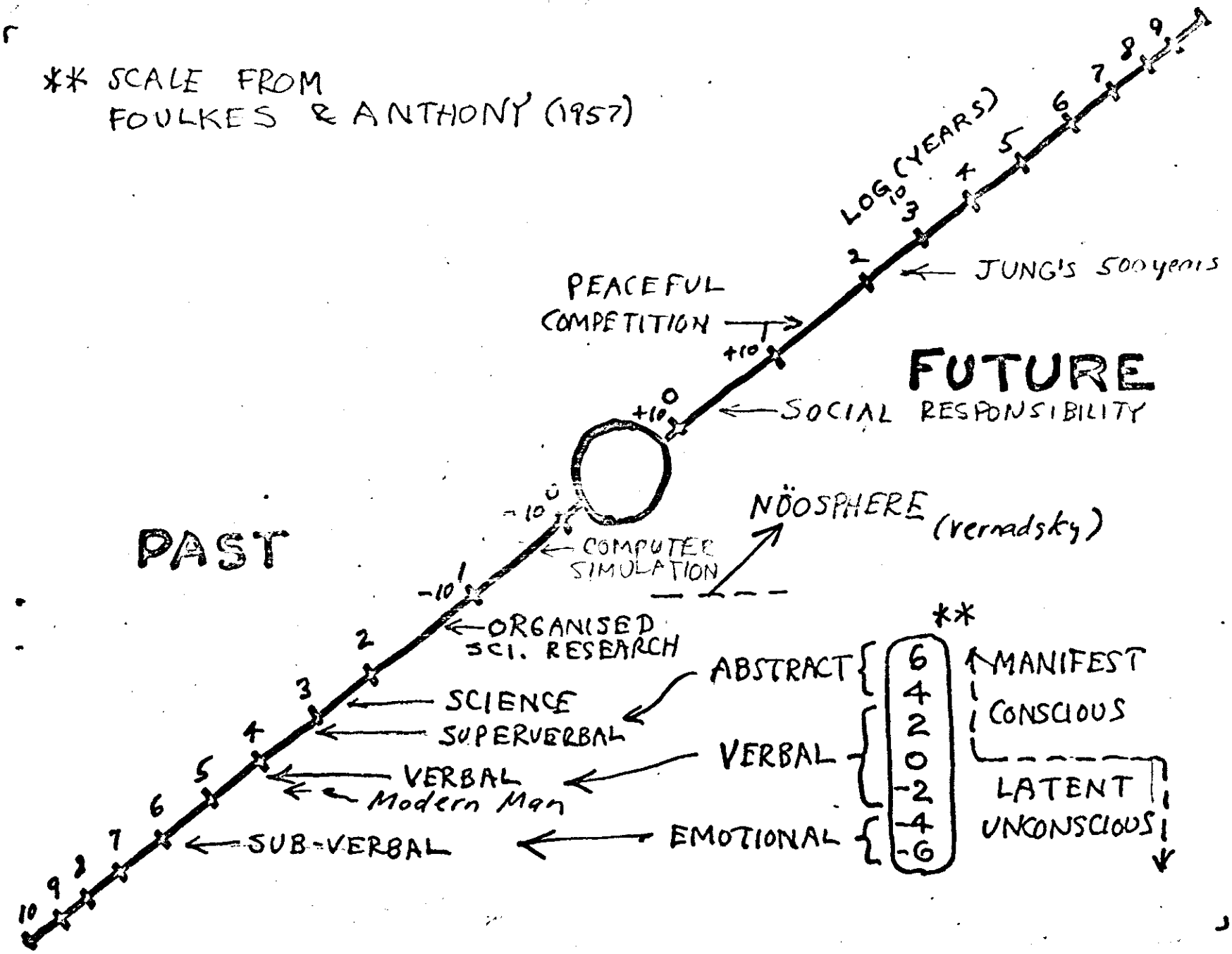
An estimate of the time span of the problems of arms control and disarmament lies in the domain of:

Plus two	Establishment of peaceful competition.

It is estimated that a preliminary step required for a succesful program of arms control leading to disarmament is the assuming of social responsibility by more individual professional people:

Plus one	Development of individual social responsibility.

** SCALE FROM
FOULKES & ANTHONY (1957)



Slide 5. Mankind's Mental and Social Development on a Gaussian Perspective Scale.

F. Checking Charts for use similar to the Covering Theorems in Functions of Real Variable (Mathematics) and to the Completeness Theorems of Electromagnetic Theory.

This part of the project is an inquiry as to what type of coordinate system or space can be used to relate different analyses of the major problems of our civilization. The three types of axes anticipated are:

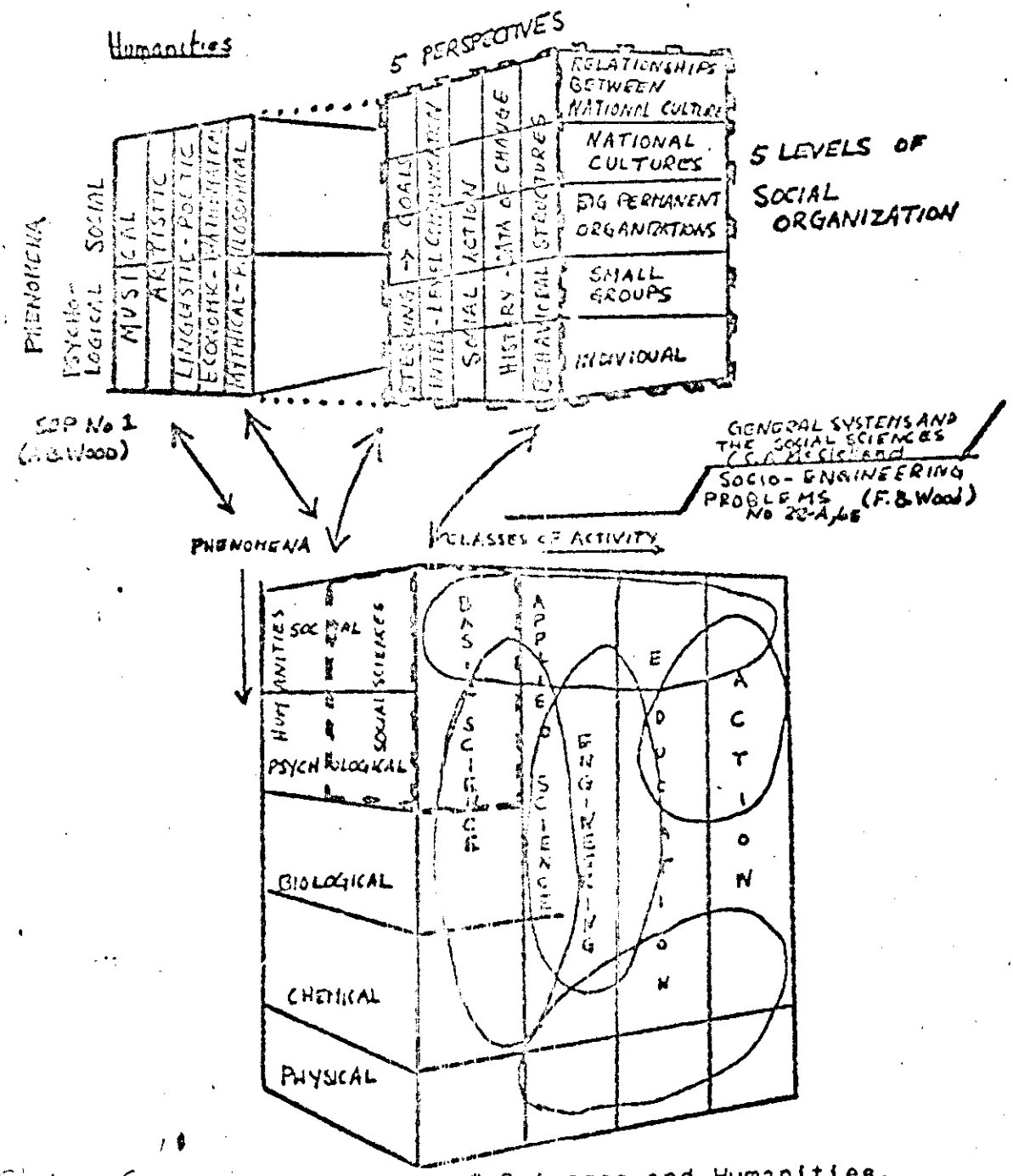
(1) The different phenomena which occur in nature,
(2) The classes of human activity with respect to these phenomena, and
(3) The different perspectives of significance in the study and use of knowledge, such as a range from humanistic-intuitional to scientific-logical.

This type of investigation is an analog in the philosophy of science of the development of covering theorems in mathematics. It is intended to reduce the chances of omission of important insights, due to the following of a single apprpach to a problem.

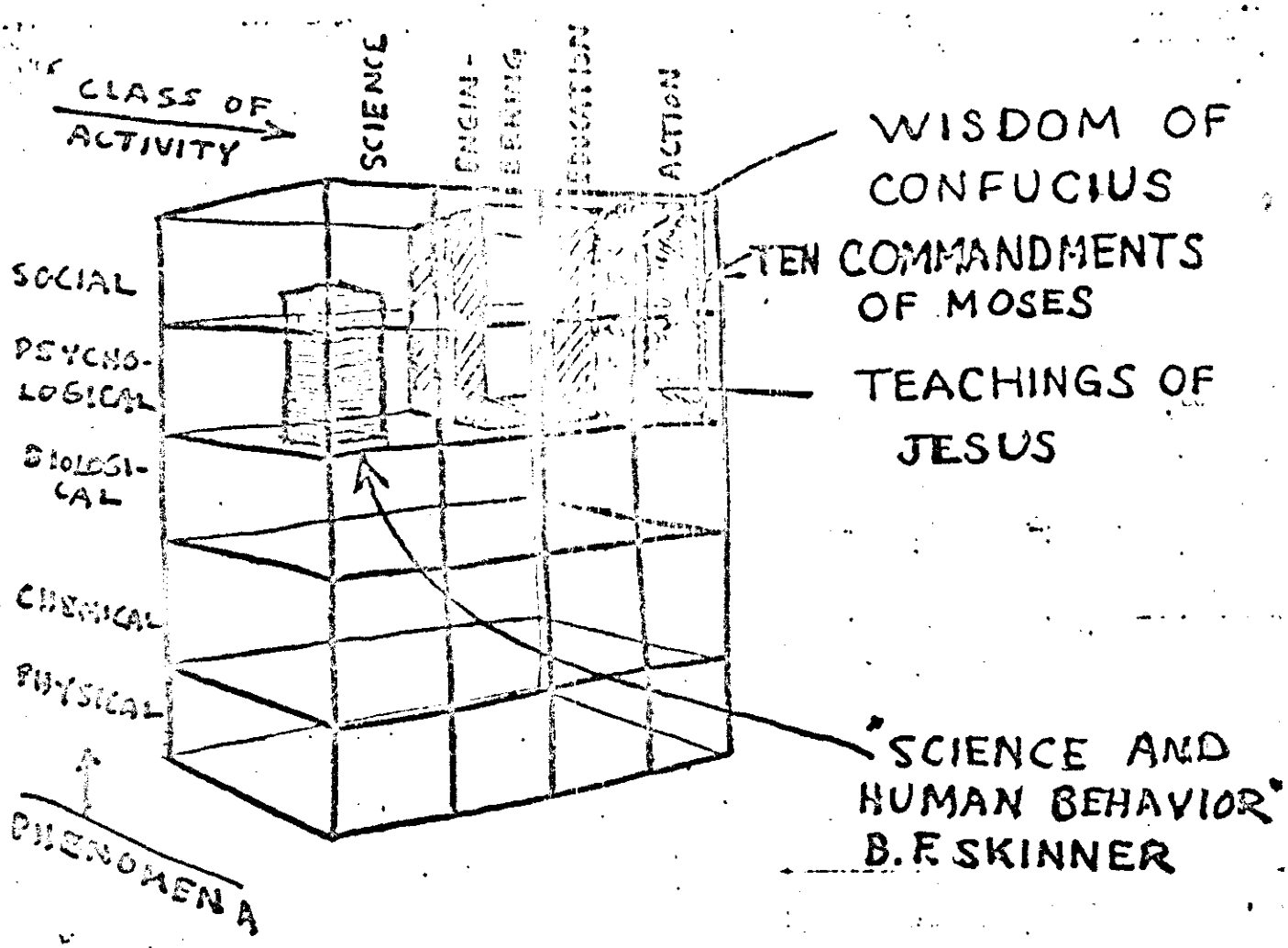
A method of placing important teachings from the humanistic tradition on the coordinate system is shown in Fig. 6. Here the Ten Commandments of Moses are shown in the "action" column covering principally the phenomena levels of social and psychological. The Teaching of Jesus are shown principally in the "education" column, because they require more meditation to interpret for application to individual situations. The Wisdom of Confucius is shown overlapping both "education" and "action." Note that these blocks of teachings, wisdom and commandments are placed at the back of the coordinate system approximately over the "mythical-philosophical" region in Fig. 5.

As an example, a block has been added to Fig. 6 showing B. F. Skinner's organization of the knowledge of psychology(80) in the Science column to illustrate the potential interaction between the knowledge of science and the goals from religion to help mankind evolve a better society.

2.8A



Slide 6. Classification of Sciences and Humanities.



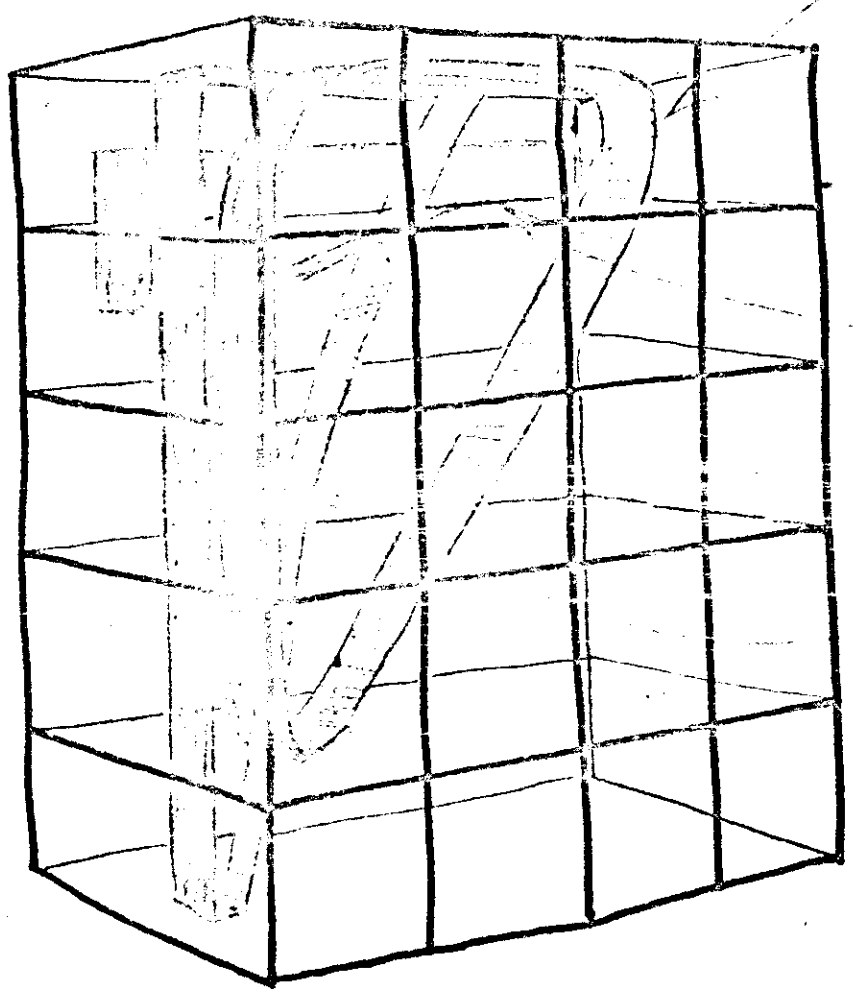
Slide 7. . A Location of the Work of Moses, Confucius, and Jesus on a Tentative Coordinate System Plus a Sample Location of the Knowledge of Modern Psychology.

Further examples of the plotting of the range of coverage of different sociologists, philosophers, pyschiatrists, anthropologists, and biogeochemists are shown in the following slides:

Slide 8. A Comparison of the Domains of the Works of Auguste Comte, Karl Marx, and Lester Ward.

Slide 9. A Comparision of the Domains of the Works of Freud, Jung, and Adler.

Slide 10. A Representation of the Domains of the Work of the Soviet Acadamician Verdnasky and the Catholic Priest-Anthropologist Teilhard de Chardin.



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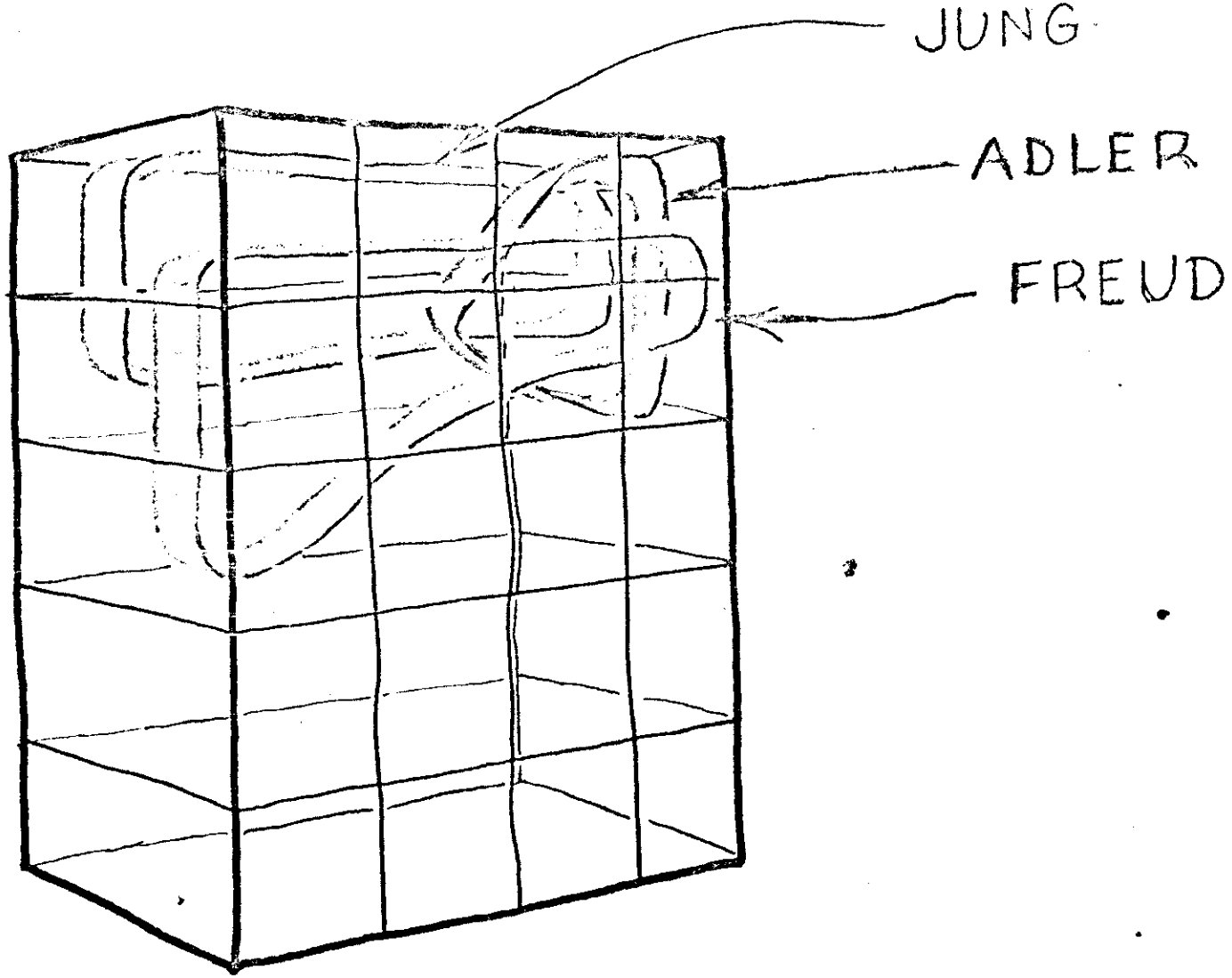

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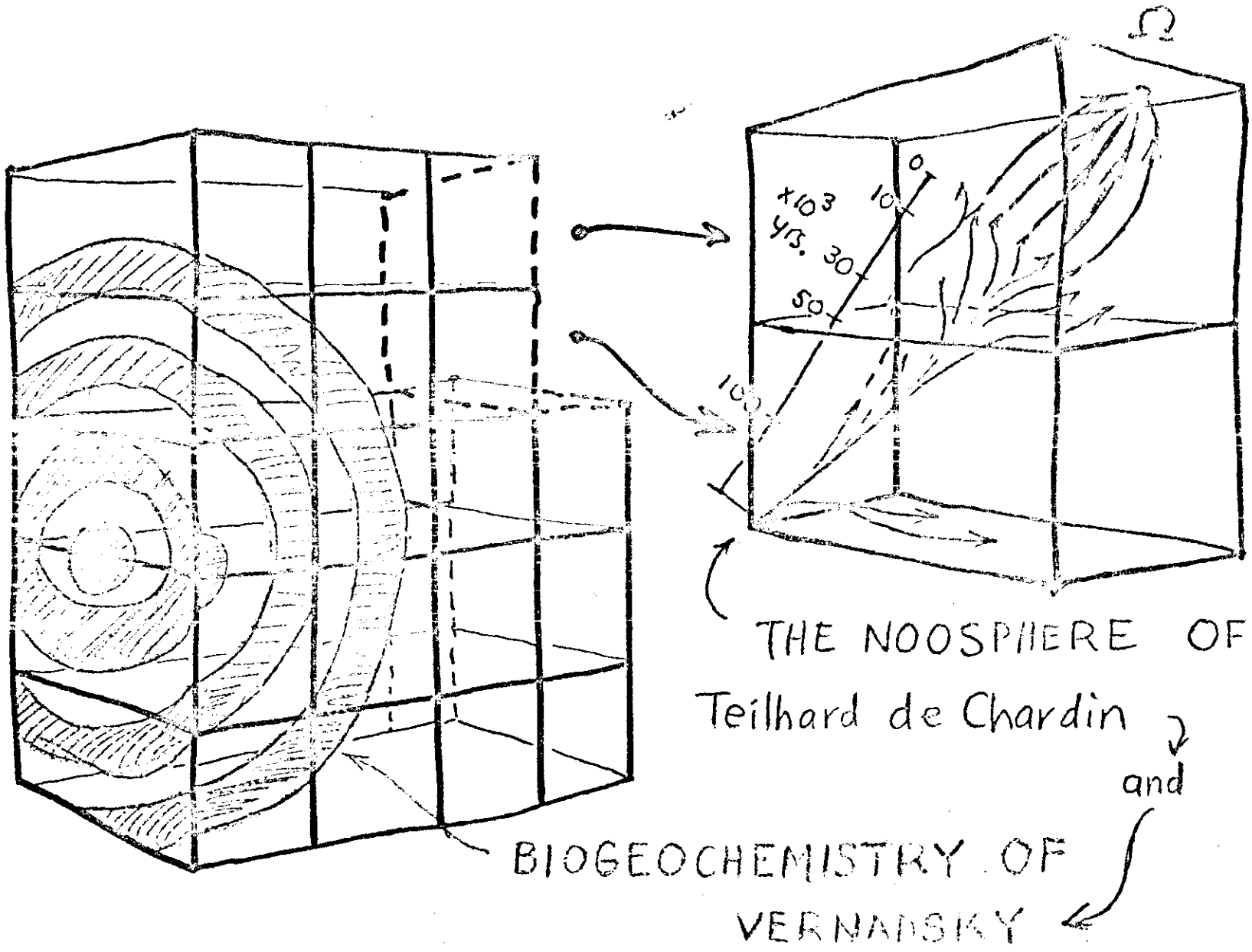


Slide 10. A Representation of the Domains of the Work of the Soviet Acadamician Verdnasky and the Catholic Priest-Anthropologist Teilhard de Chardin.

C. A Measure of Democracy Based Upon the Information-Entropy Metaphor Using a Discrete Channel.

In a paper scheduled to be given elsewhere I have developed a measure of "democracy" using the concept of information or negentropy from Information Theory.(7) The results are summarized below.

The entropy of the set of messages is defined as:

$$I = \sum_{i=1}^{n} p_i \log p_i \qquad (1)$$

where p_i is the probability that the i-th message will be sent. Since the probability p_i is a positive number between zero and one,

$$\log p_i \leq 0,$$

we can define the negentropy as minus the entropy,

$$H = -I, \qquad (2)$$

or

$$H = - \sum_{i=1}^{n} p_i \log p_i \qquad (3).$$

The choice of the base of the logarithm to the base two is arbitrary. For this study eq. (3) becomes:

$$H = - \sum_{i=1}^{n} p_i \log_2 p_i = \sum_{i=1}^{n} p_i U_i \qquad (4)$$

where $U_i = - \log_2 p_i$ is sometimes called the "uncertainty."

To assign a numerical value to "freedom" is a difficult task. There are many kinds of freedom, some of which are more valued than others. The ideal way to start this section would be to get some social psychologists to determine the relative weights to different types of freedom. Since such information is not presently accesible to me, I shall assume the following ten kinds of freedom to have equal weight in order to obtain some trial

7. F. B. Wood, "Negentropy and the Concepts of Freedom, Democracy and Justice." Paper to be presented at the Society for General Systems Research, Cleveland, Ohio, December 27, 1963. (Manuscript SGPR No. 88)

calculations.

I shall assign to each person a unit of "freedom" $F_i = 1.0$ If he is deprived of some of his freedom his F_i becomes less than one and the person or persons interfering with his freedom have F_i's greater than one. For example if a dictator reduces the freedom of his subjects to 0.5 and there are 100,000 people under his control then the dictator's freedom is $F_i = 50,001$. To obtain a measure of freedom that behaves like a probability function, we define a normalized "freedom" function,

$$G_i = F_i / n \qquad (12)$$

where n is the population of the country or sub-system. In the above case the normalized freedom for each subject becomes $G_i = 0.5 \times 10^{-5}$ and that of the dictator $G_i = 0.50001$, i.e. the dictator has 100,000 times the freedom of a subject of his.

In these sample calculations the measure of freedom is arbitrarily between the following components of freedom (Slide 11),

(1)	Freedom of speech	0.1
(2)	Freedom of religion	0.1
(3)	Freedom to print, broadcast, televise and to listen to same	0.1
(4)	Freedom to find sexual partner	0.1
(5)	Freedom to obtain education	0.1
(6)	Freedom from job discrimination on account of race, religion, or national origin	0.1
(7)	Freedom to build or buy own home	0.1
(8)	Right to vote	0.1
(9)	Right to trial by jury	0.1
(10)	Freedom to establish small business or farm	0.1
	$\sum F_{ij} =$	1.0

Slide 11, Assumed Components of Freedom.

This analysis is a test of an hypothesis as to the analogy between "negentropy"and "democracy." We wish to see, if replacing the probabilities of a set of messages by the normalized measure of freedom of the individuals in a social system will give a value of negentropy for the system which is a reasonable measure of the amount of democracy in the social system. If such a procedure gives a higher measure of democracy to a dictatorship than to an obviously democratic society, the hypothesis will have to be rejected. If however the resultant measures of democracy fall into relative positions consistent with common sense concepts and with the more sophisticated analyses of political scientists and sociologists we can accept the hypotnesis until another hypothesis is found that gives better agreement with the available facts.

Using eq. (4), replacing p_i by G_i, and H by D, we have:

$$D = - \sum_{i=1}^{n} G_i \log_2 G_i \qquad (13)$$

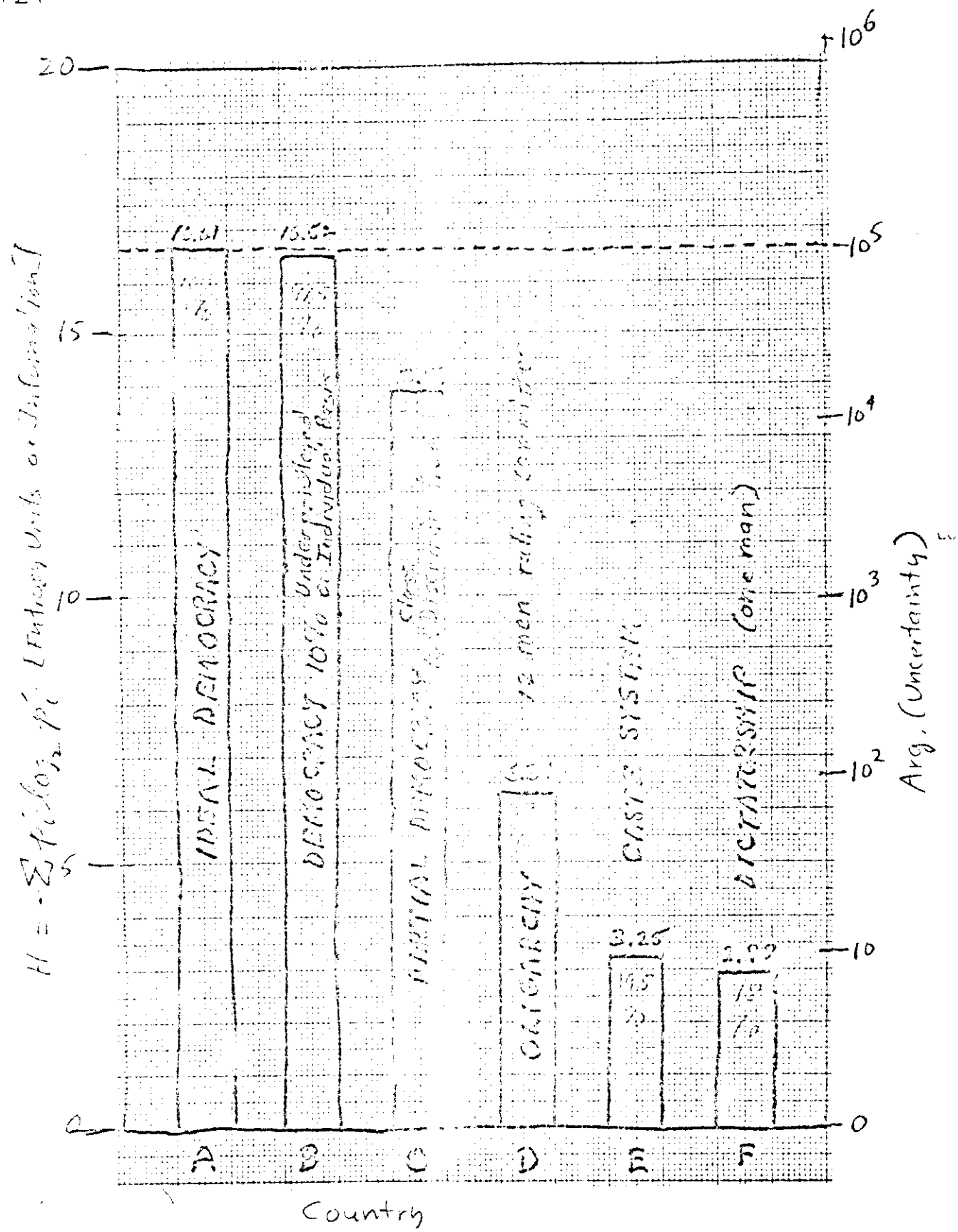
with the restraint that:

$$\sum_{i=1}^{n} G_i = 1.0 \qquad (14)$$

The subscript stands for a single individual unless otherwise noted. When a group of individuals are treated as a class without regard to individual performance, such as job discrimination on account of color, the subscript will refer to the group or class as a unit instead of to an individual.

The negentropy measures of "democracy" for each of the six hypothetical countries have been plotted as a bar graph in Slide 12 for comparison.

p. 12A



Slide 12. Comparison of the Negentropy Measure of Democracy for Six Hypothetical Countries.

Examination of Slide 12 indicates a general agreement between our theoretical calculations of negentropy with the relative degree of democracy one would ascribe by common sense to the different types of social organization. This means that we can seriously consider using the calculation of negentropy to evaluate social systems where we do not have good common sense references. However we would have to check more rigorously the method of computing the normalized "freedom" G_i.

Another feature is that a democratic country like country B can have an appreciable portion of its population with seriously curtailed freedom, provided restrictions are based on an individual basis related to individual performance and are determined by due process of law. For example having 10% of the population restricted in this way reduces the negentropy by 0.5%, while an equivalent amount of restrictions based on classification of people by race or national orign instead of individual performance reduces the negentropy by 16.4%.

Comparision of Countrys E and F indicates that a rigid caste system or a one man dictatorship knock the negentropy down to one-fifth the ideal value. Another feature of interest is that a society run by a rigid set of rules can be almost as bad as a one-man dictatorship. Another feature is that a substantial increase in negentropy results when a one-man dictatorship changes to a twelve-man oligarchy. This indicates the possibility of developing a more detailed measure of "freedom" to put into the negentropy formula to monitor changes in non-democratic systems to determine whether they are becoming more or less democratic.

D. A Measure of "Dynamic-Justice" Based on Maximizing the Negentropy of a Continuous Channel.

We have shown by analogy and by testing the hypothesis developed from the analogy that defining a measure of "freedom" as a normalized probability function, when put into the formula for negentropy of a probability distribution, results in a plausble static measure of the degree of "democracy' in the social system. This in itself is an important step in bridging the gap between mathematical science and the study of human values. However such a test must repeated as separate analyses at different times to obtain a dynamic trend indicating whether the more democratic countries can survive the interaction with the more dictatorial countries.

For example Country A with its maximum negentropy making it an ideal democracy, might be inadequately organized to deal with aggression by the dictatorial Country F. I propose as a future research problem, the search for a measure of "dynamic-justice" which might balance maximizing democracy with organization so that the more democratic countries could defend themselves without losing their "domocratic" properties. I propose that this concept of "dynamic-justice" be used for a dynamic measure of democracy related by analogy to the capabilities of the toatal system to maximize negentropy over a period of time. This would involve the time derivative of the negentropy of a system including sub-systems of different types of social structure. Such a concept of "dynamic-justice" would be clearly related to Albert Schweitzer's concept of "reverence for life."

To develop such a dynamic model would require filling more structure than is available for this study. To procede on from

this static measure to a dynamic measure requires the addition of feedback loops to the system in which the different countries are interconnected. The interaction of Countries B, C, D, E, and F upon Country A could be interpreted as noise in the communication channel corresponding to Country A. To obtain a noise probability distribution we would need some knowledge of the signal power level in each sub-system and the extent of coupling between them.

To procede to this next step is beyond the scope of this study. However one can conjecture that the direction of further research might be to investigate the possibility that "dynamic-justice" might be measured by a corelation function between the actual probability distribution of freecom in Country A with the optimum freedom distribution computed from an analysis of the analogous communication channel with noise derived from the other countries in the system. It is premature to to attempt a specific model of "dynamic-justice" on this basis. To develop this power level, it is necessary to determine some measure of the scientific, educational, and economic levels of the sub-system countries.

However ther is something we can try even though we lack:

(1) a suitable definition of power level of a social system, and

(2) a knowledge of the equivalent noise distribution of a social system.

We can attempt toamke a trial calculation using the following assumed features to test plausibility of our hypotheses of using the continuous communication channel as a model of social systems:

(a) use the electric power production per capita of a country as a measure of its variance, and

(b) assume a Gaussian probability distribution of political views is equivalent to noise in a continuous communication channel.

For the above assumptions, we have from the continous channel in electrical communication theory, a formula for the entropy:

$$H_x = \int p(x) \log p(x)\, dx.$$

For an electrical signal carrying a message on a physical channel such as a pair of wires or a radio channel with random noise and an average power, σ^2, there is a theorem in Information Theory showing that negentropy is maximized when the message distribution is Gaussian,

$$p(x) = [1/\sigma(2\pi)^{\frac{1}{2}}]\, e^{-x^2/2\sigma^2}.$$

For the social system I shall take as a "thematic hypothesis" that a similar theorem exists. In the social system the distribution may not necessarily be gaussian, but as a starting point I shall use a gaussian distribution as a first approximation. A convenient parameter to start with for plotting power distributions, say in respect to political views is

$$P(x) = \sigma^2 \cdot p(x).$$

A sample set of such curves are plotted in Fig. 13 (or Slide 13).

The important feature of this model is that the "tails" on the gaussian probability distribution must be preserved in order to maximize the negentropy. The average power (σ^2) in the electrical circuit may be analogous to the energy available per capita per year for a social system. Then as a country develops, the variance spreads out.

Some examples illustrating the "tails" that must be preserved for optimum functioning of a social system are shown in Slide 14. If the shaded portions of the distributions are missing for the powerful countries, disarmament negotiations are likely to be hazardous, whereas if the tails are preserved, each country has an optimum political system for its stage of development and is less likely to attack other countries, because it can deal with its internal problems.

PER CAPITA

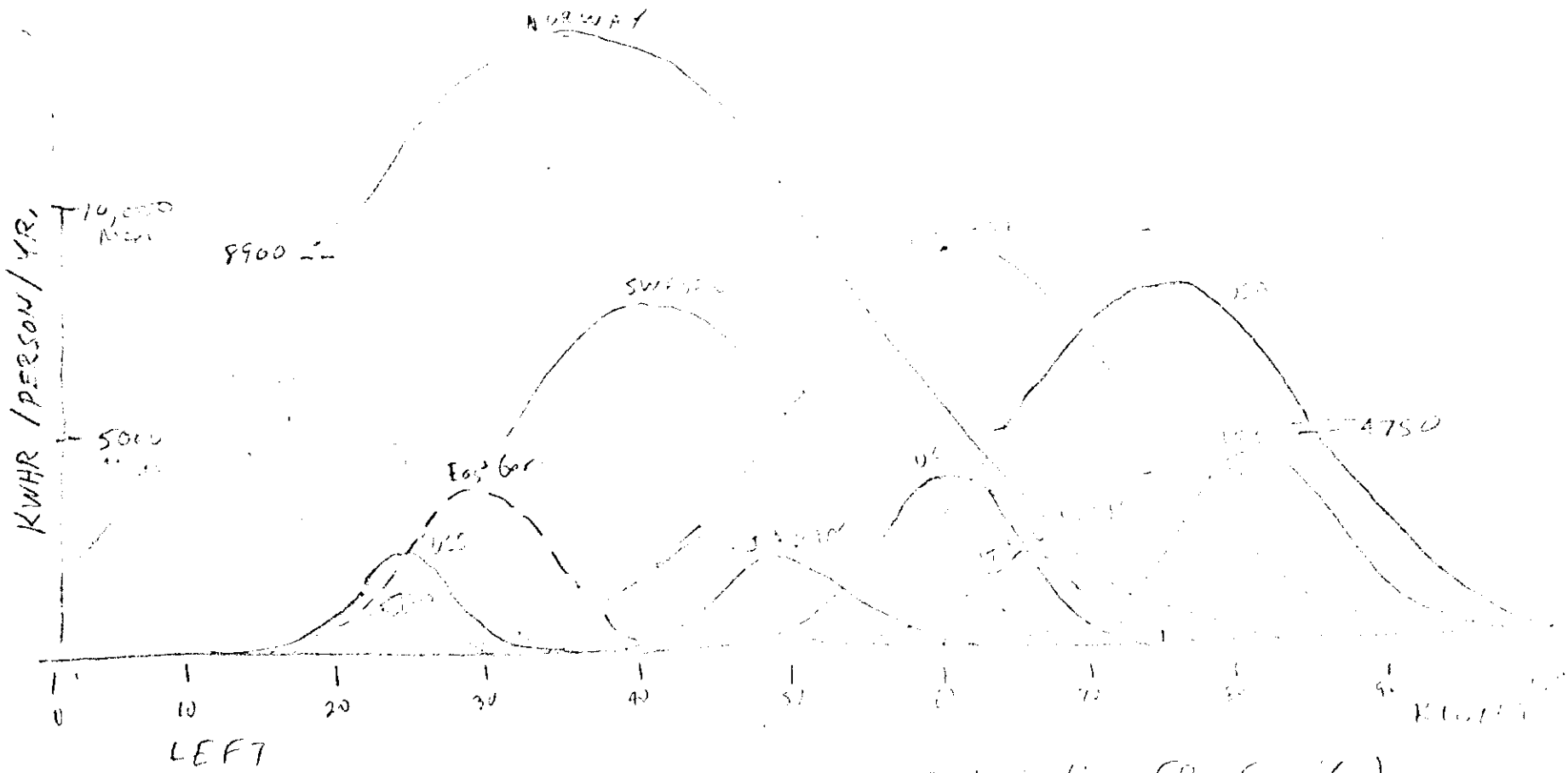
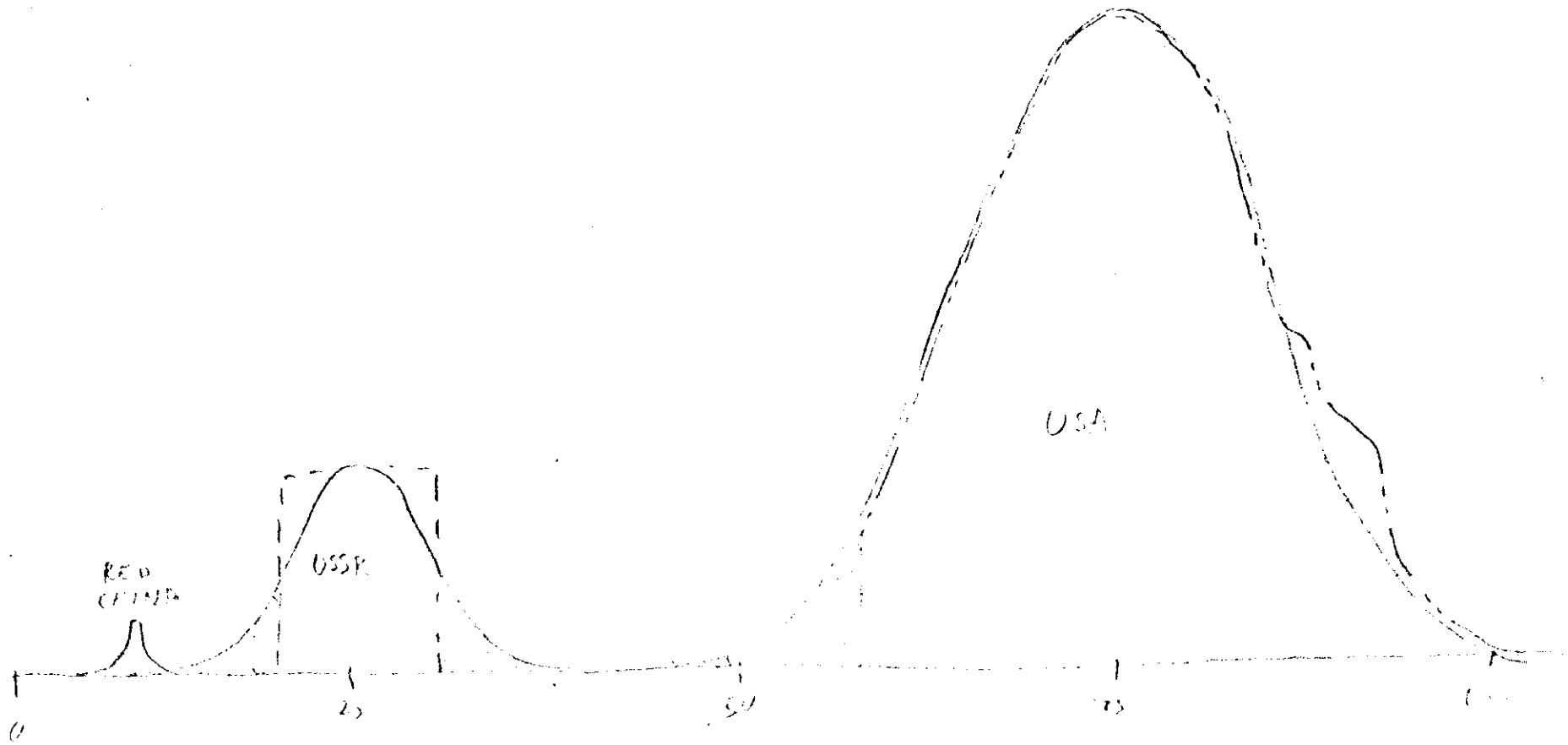


Fig 13. Theoretical Electric Power Distribution (Per Capita) vs. Political Grouping of Population

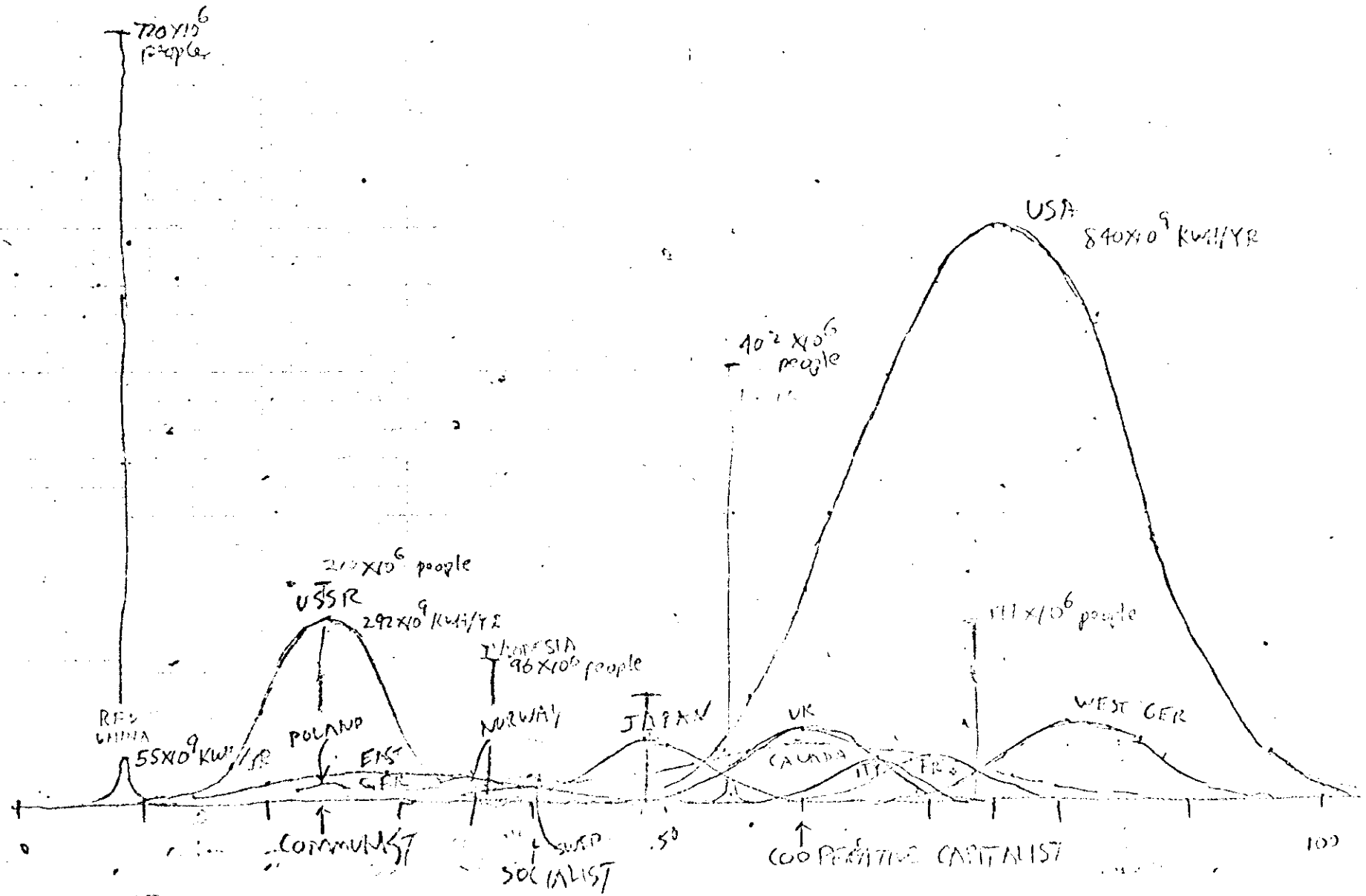


Slide 2. Examples of Departures from Trial Distributions

To embark on successful arms control and disarmament negotiations requires studies to determine what constitutes optimum social-political probability distributions and then finding ways to maintain the tails of the distributions for the major countries.

In the meantime with our rough approximations we can gain valuable insights as to the nature of the international conflicts and the relationship between economic level of development and capabilities for evolving democratic governments.

In Slide 15 we have upper and lower bounds on the military potential of the major countries. When population and electric power distribution don't come close on the chart, the relative military strength of the country is some mean between the two bounds. This type of chart helps us pinpoint which countries may make disarmament difficult.



Slide 15, Population Distribution & Ideal Electric Power Distribution

IV. Summary.

Four philosophical "tools" for use in developing better insights into the disarmament problem have been developed. In the absence of precise testing methods and insufficient data, thematic hypotheses have been developed to select what assumptions and approximations to make for a first approximation. These hypotheses have not been generated out of thin air, but have been carefully developed from studies of the possible analogies extending through the main levels of natural phenomena in our universe. The methods of the physical scientist have been carefully analysed to see how hypotheses are developed and tested. In particular two approaches have been pursued: (1) the testing of hypotheses in regard to the Special Theory of Relativity, and (2) the general process of developing thematic hypotheses as is discussed by current philosophers of science.

In an attempt to develop a perspective with respect to time for comparing the disarmament problem with past and future crises of human civilization, a pseudo-Gaussian probability curve form of plotting significant events has been developed. This type of curve combines the features of the histomap(logarithmic) and Gamov's linear past and future projections. An attempt to select the major steps of mankind's mental and social development leads to the suggestion that the development of individual responsibility of professional people in the major powers is a necessary first step that must be in process before the more obvious problems of arms control and disarmament can be cleared up. This suggests that individual scientists and engineers in the U.S.A. must acquire the perspective and learn to have the courage to take stands on public issues independent of the policies of the institution for which they work.

This further leads to the suggestion that more attention must be paid to the great religious leaders of the past whose teachings form the base of the major cultures on this planet. Care must be taken to distinguish between rules based upon pre-scientific knowledge and deep psychological insights.

In order to deal in perspective with both the great teachings from the past and recent findings of science, we need a second "tool", namely some kind of ...phenomena/stage/method...perspective. An extension of the tables and lists of the early sociologists---Auguste Comte, Herbert Spencer, and Lester Ward---has led to a three-dimensional perspective chart. This chart is useful for plotting the main emphasis of great leaders such as Confucius, Moses, and Jesus to help people perceive how these great leaders were working at different points in the stge and method plane in the perspective diagram. In these three dimensional diagrams the coordinates are: (1) Phenomena, which run through physical, chemical, biolcgical, psychological, and social; (2) Stage, which run through basic science, applied science, education, and decision making; and (3) Method, which runs from religious-intuitive, humanistic-poetic, through scientific-logical. This type of perspective makes it easier for people to perceive the possibilities forseen by philosophers like F.S.C. Northrup, scientists like Vernadsky, anthropologists like de Chardin, and psychiatrists like Jung. This type of perspective makes it easier for people to perceive the differences in the background of the U.S., U.S.S.R., and Red China which lead to ideolgical conflict. Such perspective may lead to an easier perception of the unique contributions of the different cultures to a future peacefully competitive world.

The third philosophical tool is a measure of democracy in a social system. This measure of democracy is derived by analogy from the probability distribution of messages on a telegraph line as it is analysed in Information Theory. First an attempt is made to define a numerical scale for individual freedom.

Lacking any recognized weighting of different components such as freedom of speech, freedom of religion, etc., ten principal freedoms are arbitrarily given a value of one-tenth, such that an independent individual has a freedom of $F_i = 1.0$, or a normalized freedom of $G_i = F_i / n$, where n is the population of the group, country, or system being considered. Using this approximate definition of normalized freedom, a set of graphs of probability distributions of freedom are made for six hypothetical countries of 100,000 population each: an ideal democracy; an imperfect democracy; a partial democracy with an upper class, a large democratic middle class, and a lower class; an oligarchy ruled by a committee of twelve; a country structured by a caste system; and a dictatorship.

Next a measure of "democracy" is developed by analogy with Information Theory in which the normalized freedom corresponds to the probability of a message being sent, and the measure of democracy is the negentropy of the probability distribution. The calculated negentropy for the different social systems are:

Ideal democracy	16.61
Approximate democracy	16.52
Partial democracy with upper & lower classes	13.90
Oligarchy	6.31
Caste system	3.25
Dictatorship	2.98

Even though the definition of freedom is weak, the numerical measures of "democracy" for the above systems are reasonable and do not conflict with common-sense values.

This measure of democracy is a tool which should be useful in evaluating the state of development of the various countries involved in disarmamant discussions. Knowing the state of development of the significant countries should help us determine whether the time is suitable for a limited arms control program or for a more basic drive for disarmament. If there are temporarily stabel non-democratic countries which are powerful, it takes very careful anlysis to justify a disarmament program.

A more fundamental limitation on the above procedure is that the measure of democracy is a "static" measure. It does not give a direct measure of the ability of the democratic state to maintain itself with time, i.e., to be able to protect itself against attack by a dictatorship. It is proposed that the concept "dynamic-justice" be narrowed from the present dictionary definition to include an additional measure of the ability of the system to preserve and increase its democratic properties over a period of time, say one generation.

The above definition of "justice" requires a more complicated model than the single communication channel used for the static definition of "freedom" and "democracy." For example Countries A through F could be considered as six communication channels in which each channel would have a noise signal derived from the other five channels. This would require the analysis of a complex network of feedback loops which are beyond the scope of this study. If the number of countries in the system were large and represented a random distribution of social organization, it

might be possible ot formulate the approximate effect with a gaussian noise model. A possible path to try to get a measure of "dynamic-justice" would be to investigate the correlation function of the normalized freedom function and the optimum freedom function predicted for maximum negentropy of the channel under the given noise distribution.

In the absence of accurate data, a model based upon the continous channel from Information Theory has been investigated using the per capita electrical energy production to compute the variance. This model yields some unverified, but plausible models of the optimum distribution of political ideas about an arbitrary reference point. This fourth philosophical tool leads to insights as to the method of investigation of whether "peaceful coexistence" is likely to be a true peace or a snare and a delusion to weaken the democracies. A preliminary test is provided by this fourth philosophical tool even though incomplete. This test is whether the country in question is developing to come closer to the optimum political view distribution appropriate to its stage of development. By this test Hitler's Germany was departing farther and farther away from the theroetical curve corresponding to the stste of development of Germany. At precent there many signs that the Soviet Union is moving closer to their optimum curve for their present stage. The insights developed form this analogy from Information Theory leads us to perveive that there are conditions under which powerful democracies, oligarcies, and dictatorships can peacefully coexist, if their repsective internal distribution of political ideas fit reasonably well to the theoretical curves for their stages of development. There is a possibility that this theory fails at some points sucha at the "take-off" point in W.W. Rostow's theory of economic development.

Together these four philosophical "tools" offer us greater insight into the conditions necessary for disarmament and can help lead us to tap some of the potential sources of constructive cooperation within the countries in conflict.