Symposium at Meeting of the
Society for General Systems Research
Philadelphia: Symposium Area X:
Peace Development.
Area Chairman: Dr. Harold Chestnut

Session Title: "APPLYING SYSTEMS THEORY TO THE PROBLEM OF WORLD PEACE: A CASE STUDY OF GLACIAL CYCLES AND CLIMATE CHANGE."

Session Organizer and Chairman:
Dr. Fred Bernard Wood,
Computer Social Impact Research
Institute, San Jose, CA.

Time: Tuesday, May 27, 1986;
8:00 a.m. to 9:45 am.

Place: "Solution Room" in Law
School Building, University of
Pennsylvania, near 34th St. &
Chestnut St, Philadelphia.

CO_2 & CLIMATE

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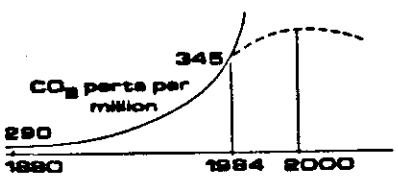
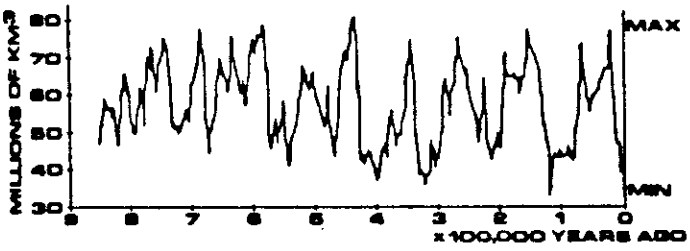


ATMOSPHERIC CARBON DIOXIDE INCREASE AND PROPOSED REDUCTION



VARIATION OF GLOBAL ICE VOLUME

A NEWSLETTER ABOUT CYCLES OF GLACIATION, THE NEGATIVE EFFECTS OF AN INTERGLACIAL/GLACIAL TRANSITION ON LIVING SPECIES, AND A COUNTER PROGRAM.

VALUES IN DECISION MAKING ON WORLD PROBLEMS

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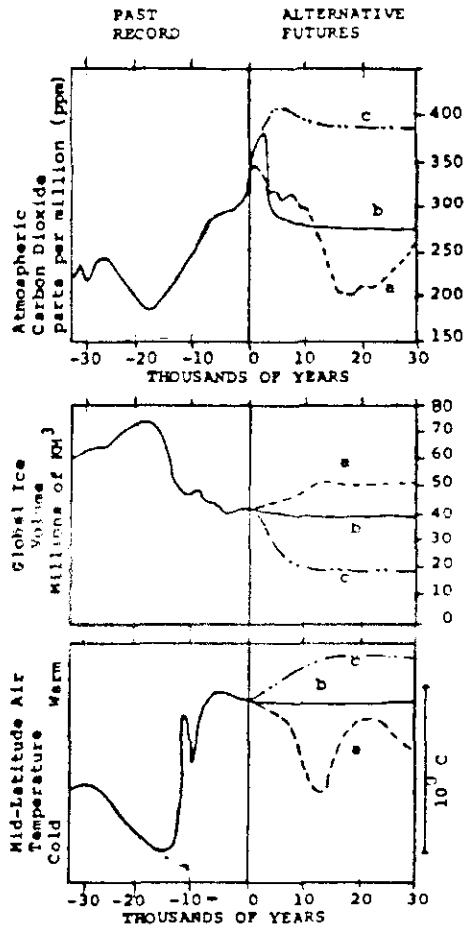
ABSTRACT

This is the introductory paper of a symposium of six papers on "Applying Systems Theory to the Problem of World Peace: A Case Study of Glacial Cycles and Climate Change." The objective of the underlying study is to see if there exists a major world problem of less intensity than nuclear war that however is a significant enough threat to civilization to push the major contestants in world politics to learn to cooperate in combatting this common threat. It has been developed as a scenario of what could be done by a Congressional Foresight Office, if it had on its staff some experts in computer simulation, experts in decision theory, librarians expert in information retrieval, and consultants on call from the twenty-five areas of science involved plus experts in engineering synthesis, and cybernetic systems theory, general systems theory, and philosophy of science. This scenario goes through a series of steps, starting with a computer spread sheet based table of major world problems. A sample print-out of the world problems spread sheet will be shown at a A.A.A.S. poster session.

The glacial cycle of our planet and resultant climate change is selected as a test case throughout this scenario since it illustrates a case where the resultant world-wide starvation in a few years is such a potential common threat. The scientists doing research on the climate problems expect to have important answers about the climate changes on our planet in about five years. However engineers who have studied the climate change problems say that we will miss the period during which there is a simple solution, if we wait for the scientific research results. Waiting for scientific certainty may result in more than two billion people dying of starvation.

Tremendous strides have been made in the last twenty years in paleoclimatology. Chemical and isotope analysis of cores of ocean bottom sediment, trapped air bubble analysis of Greenland ice cores, pollen analysis of lake bottom cores, and tree ring analysis now give us an understanding of the historical variation in ice volume, temperature, and atmospheric carbon dioxide concentration. The glacial ice volume variation for the last 900,000 years is shown in Fig. 1. The pattern is a series of glacial periods of from 70,000 to 120,000 years duration each separated by an interglacial warm period of 10,000 to 12,500 years duration. Fig. 2 shows the atmospheric carbon dioxide, global ice volume, and mid latitude air temperature for the last 30,000 years with three alternative future projections of the curves for the next 30,000 years.

Fig. 1 is "Variation of Global Ice Volume" on bottom center of cover page



Columns a, b, c in Table I: Regret Matrix correspond to curves a, b, c above.

Fig. 2. Projection of Alternative Futures.

Since some of the major problems involve unresolved questions in science, our path is directed toward methods of decision theory under uncertainty. Of the many alternative matrix representations available in decision theory, the regret matrix is selected as a useful type for climate change. Then the minimax criterion is selected to aid in evaluating alternative policies for reducing the maximum loss of human lives from starvation due to crop failures following climatic changes. The regret matrix is formed with possible states of nature in columns and alternative policies in rows. The values in the regret matrix are the estimated number of human lives lost by starvation between 1983 and 1995 on our planet for the action described by the row and the type of climate change (state of nature) described by the column.

Six alternative actions are included in the regret matrix. The action with the greatest maximum regret is "Do nothing" which shows 2 billion lives lost.

TABLE I: REGRET MATRIX FOR CLIMATE CHANGE

Estimated number of people dying from starvation on planet Earth from 1983 to 1995 for different states of nature and different alternative actions taken.

POSSIBLE ALTERNATIVE ACTIONS ↓	STATES OF NATURE --->	STARVATION DEATHS ON PLANET EARTH DURING PERIOD 1983 TO 1995		
		a	b	c
		GLACIATION INCREASING NOW	GLACIATION REMAINING AT PRESENT LEVELS	WARMING PROCEEDING NOW
DO NOTHING		2,000 M	24 M	12 M
REMINERALIZATION & REFORESTATION STARTING NOW		250 M	12 M	12 M
REMINERALIZATION & REFORESTATION STARTING IN 5 YEARS		1,200 M	12 M	12 M
DISCONTINUE BURNING OF FOSSIL FUELS		1,000 M	8 M	8 M
REORGANIZE DISTRIBUTION OF FOOD		1,000 M	8 M	8 M
GROW SPIRULINA ALGAE FOR FOOD		700 M	6 M	6 M

"M" means 1,000,000 in this table.

The action with the minimum maximum regret is "Remineralization of the soil & Reforestation Starting Now" and shows a maximum regret of 250 million lives lost due to starvation following climate changes. Even though we don't know which of the three future projections of climate change is correct, the use of the regret matrix with the minimax criterion shows us which action gives us the smallest maximum loss of life, regardless of which of the three projections of climate change is correct.

EVIDENCE OF CURRENT GLACIAL PROCESS:
Geophysical and ecological data indicate that we are at least moving into another mini "Glacial Period."

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Nebraska Academy of Sciences, Inc.; and
Department of Geology and State Museum
University of Nebraska-Lincoln; and

Mariar[illegible] Schultz,
Institute f[illegible] Ter[illegible] Quaternary Studies
Li[illegible]ln, [illegible]ska 68588

INTRODUCTION

Interdisciplinary studies indicate that the Quaternary ("Great Ice Age") started some 3.0± million years ago. Although there have been at least eight major eustatic cycles of varying length during this time, it appears that there have been numerous additional minor cycles, especially during the Late Quaternary. The cycles apparently were varying in length during the past 800,000 years and the rate of the formation of terraces, through the process of cutting and filling, began to increase at a more rapid rate./

The inhospitable climates of the Illinoian and Wisconsinin glaciations contributed greatly to the reduction in numbers of grazing animals, and there was a general trend toward desertification. As much as 56 meters of loess was deposited during the Late Quaternary and the largest sand dune area (Nebraska Sand Hills) in North America developed. The horses and camels, which had so successfully lived in the Great Plains Region for more than 40 million years had some very aggressive competitors for the grasslands during the latter part of the Quaternary when the giant bison, mammoths, and other large mammals arrived from Asia just prior to the Illinoian glaciation. These migrant forms consumed great quantities of grass and herbs, which hitherto had supported the native grazers. The dimunition in size and aggressiveness of the bison and their ability to adjust to environmental changes, undoubtedly contributed to the success of the bison to survive. Even the mammoths began to decrease in size during the past 30,000 years but they too like the native horses and camels became extinct at the beginning of the Holocene some 12 thousand years ago. However, small herds of a few horses and camels were able to survive locally in the southern United States until some 8 thousand years ago.

There has been a tendancy to consider the geologic history of the "Great Ice Age" in a much too simplistic manner. Even during the past 1,200 years the climate has been variable, and weather that we have considered as normal during much of the 20th Century has been abnormal. There have been three mini "glacial periods" (minor "Ice Ages") of varying length since 800 A.D. which have caused human populations, as well as animals, to abandon regions with very inhospitable weather

and to move to lands which had more favorable living conditions. These lands were already overcrowded and the collapse of cultures resulted. Numerous wars were fought for land, food, and a diminishing supply of water.

During the three minor "interstadial" periods, climate was more favorable for agriculture, trade, and cultural advance. The present or third "interstadial" period has only lasted from early in the 20th Century and now it appears that we are already entering another mini "glacial period," or perhaps a major one. This trend toward a colder climate has been observed since the 1960s, and the mean annual temperatures have continued to drop since 1947, not only in the Great Plains Region of North America, but also in other areas of the Northern Hemisphere.

The increased CO_2 in the atmosphere during the "Industrial Era" has not caused a warming or "greenhouse" effect as had been predicted. Perhaps the increase in particles in the atmosphere and other factors have nullified the effect of the CO_2. Only when data from as many different scientific disciplines as possible are considered can an adequate systems model be made to predict the future. If we are again to have a mini "glacial period" in the late 20th and early 21st centuries, the relocation of large human populations must be planned in advance in an orderly fashion if we are to avoid wars for food and water. The regions with favorable climates are already overpopulated and in many places facing major drought periods.

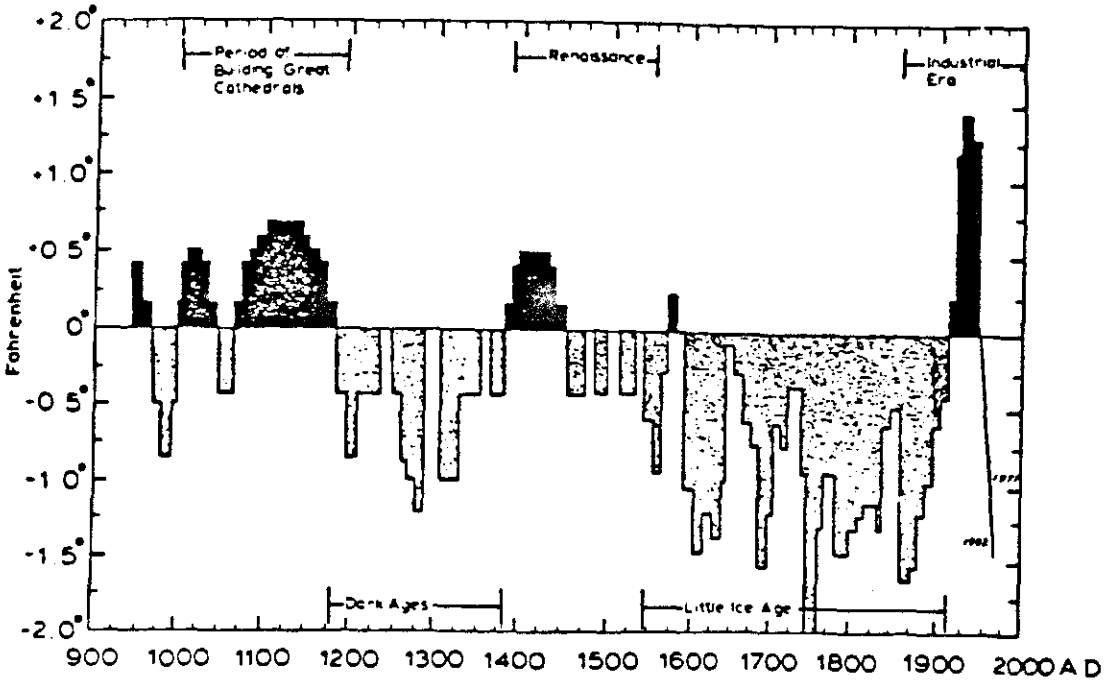

Figure 4. Chart showing temperature changes in Iceland during the past 1,000± years. The events shown in the chart indicate how complex the entire Quaternary history must have been, since this represents only the time of the formation of the lowest 6 m-high Terrace-0 valley-fill in the central Great Plains of North America (1,000 yr. of the 3 m.y. history of the "Great Ice Age").

THE CLIMATE CYCLE, AN EXTRACT FROM THE HAMAKER THESIS ON SURVIVAL

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ABSTRACT

The book, The Survival of Civilization (Hamaker and Weaver, 19[illegible] is a Thesis on [illegible] the 100,000 year Glacial-Interglacial Cycle wor[illegible] demineralizati[illegible] of the soil; deforestation; rising carbon dio[illegible]e in the atmosphere; increased moisture evaporated by gre[illegible]house effect; more cloud cover and precipitation in polar regions; automatic glacial cycle; and how to prevent glaciation.

In Solar Age or Ice Age? Bulletin # 2 (Hamaker, 1983a) it was pointed out that Milankovitch was mistaken in thinking that the slight variations in the amount of solar energy and the location of it's incidence due to orbital effects is the cause of glaciation. However, he and those who studied the problem before him were correct in relating the orbital disturbance to the climate cycle.

The direct cause of glaciation is massive winter cloud cover over the upper latitudes and upper middle latitudes. The high reflectivity of the clouds simply excludes enough of the total solar energy supply from reaching the earth that the growth of the ice sheets is insured. The clouds will be produced by anything which increases heat (and therefore evaporation) in the tropical zones. The increased temperature differential between the lower and upper latitudes energizes the air flow pattern to carry the clouds to the upper latitudes. The strong wintertime flow toward one pole or the other leaves the opposite hemisphere short on water and subject to drought and excessive heat.

Solar energy is almost constant and that leaves only the "greenhouse effect" gases to cause heating, the principal one being carbon dioxide (CO/2). So all research on the climate cycle should be directed toward understanding the sources of CO/2 and understanding what activates them. The orbital factors have some importance in this regard.

Before proceeding with a discussion of the orbital factors, it should be observed that although glacial epochs go back almost two billion years, their present character appeared about 450 million years ago after the first plant life developed on land. Before plant life there were only the ocean organisms to secrete the carbon in the ocean floor. The normal condition then was one of high CO/2 in the atmosphere - high enough to produce sufficient warm clouds to wash away most of the polar ice. However, after tectonic catastrophes, which depleted the molten rock in the tectonic system, volcanism was reduced.

When the open wound in the crust was sealed, the CO/2 in the atmosphere was slowly reduced to the point where ice could accumulate and the world went automtically into glaciation. Often when the tectonic system lost a part of its fluid, a major part of the land area sank below water level providing a poor base for glaciation. Glaciation could have started up again only if the rate of input of CO/2 into the atmosphere exceeds the rate of absorption from the atmosphere into the oceans. That conditon could be met, before there was plant life, by the build-up of pressure and volume in the tectonic system but only after the very long period of time required to lift the land masses. After the establishment of plant life, the rapid death of plant life due to soil demineralization made possible a succession of 100,000-year climate cycles constituting a glacial epoch whenever there was enough continental land close to a pole so as to allow glaciation.

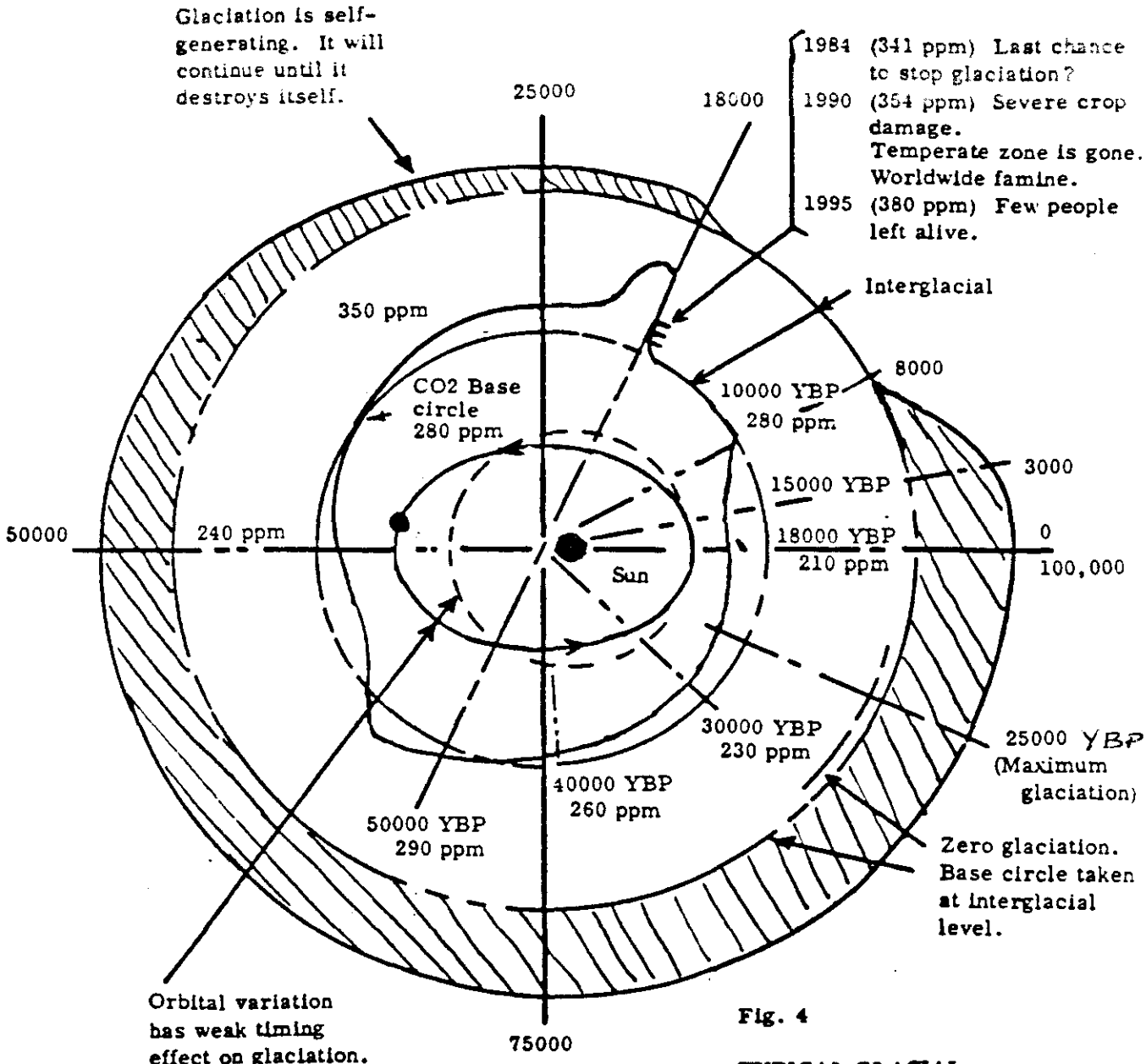

Fig. 4

TYPICAL GLACIAL CLIMATE CYCLE

The entire climate cycle can be controlled at interglacial conditins by varying the organic factors to maintain atmospheric CO/2 between 260 and 280 ppm. Failure to do so will eliminate civilization.

A SYSTEMS VIEW OF THE CARBON DIOXIDE PROBLEM

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ABSTRACT

During the past decade, a great deal of attention has been devoted to the problems associated with the accumulation of carbon dioxide in the Earth's atmosphere. Global climate models based on linear programs predict that increasing levels of atmospheric carbon dioxide will produce a "greenhouse warming" leading to climatic disruptions ranging from the flooding of coastal areas to the transformation of productive agricultural lands into vast deserts. However, an entirely different scenario emerges when the carbon dioxide buildup is examined within a systems framework. One such model, considered here, predicts that high levels of atmopsheric carbon dioxide will lead to uneven heating around the Earth, and that this differential warming will ultimately trigger the formation and expansion of polar glaciers and result in an overall cooling of the global climate.

This paper describes how the preferred-state planning methodology uncovers the heretofore undetected biological link in the chain of events leading up to the carbon dioxide problem, and leads to practical solutions to it and related problems of acid rain, soil erosion, deforestation, drought and famine.

Weather related disasters have been occurring with increased frequency in recent years. Are these isolated incidents, or are they connected in some very fundamental way? What, for example, does the snow on the Riviera have to do with the drought in Ethiopia? Is there a connection between Russia's inability to sustain a wheat crop and the citrus losses in Florida? And what about the recent devastating forest fire in Borneo and the dying forests in Germany and Lebanon? Are they related in any way?

John Hamaker, an independent scientist/ecologist has developed a theory that provides strong evidence that these phenomena are intimately linked to one another and to the increase in atmospheric carbon dioxide (CO2). He argues that CO2 along with other so-called "greenhouse gases" present in the atmosphere in unusually high concentrations are creating extreme temperature gradients around the Earth. As a consequence, rising temperatures in the midlatitudes is accelerating the rate of evaporation of the waters from the oceans to the atmosphere where it travels to the poles and contri-

butes to cloud formation, increased snowfall and the growth of the polar glaciers. Thus, the snow of the north is the drought of the tropics when viewed from this perspective.

This paper will show how the adoption of the World Game perspective can help humanity see the buildup of carbon dioxide in the atmosphere as a recurring --- and until now --- necessary function of the evolution of life on Earth that leads to devastating cycles of glaciation. I will then suggest how humans can apply Comprehensive Anticipatory Design Science and assist Nature in her efforts to maintain the condtions necessary for life in a way that eliminates the need for global climatic disruptions.

According to the Gaia Hypothesis developed by Lynn Margulis and James E. Lovelock (1975), the Earth is a living system whose grand-scale cycles of energy and chemical elements are actually regulated by the activities of the billions of organisms that inhabit the biosphere. Biological species, driven to compete with one another as they seek to satisfy basic needs, collectively and unwittingly perform the necessary tasks that optimize the conditions that are conducive to life without favoring any particular species.

Fuller (1983) developed a very insightful theory concerning humanity's role in evolution:

> In our immediate need to discover more about ourselves we...note that what is common to all human beings in all history is their ceaseless confrontation by problems, problems, problems. We humans are manifestly here for problem-solving and, if we are any good at problem solving, we don't come to utopia, we come to more difficult problems to solve. That apparently is what we're here for, so I therefore conclude that we humans are here for local information-gathering and local problem-solving with our minds having access to the design principles of the Universe and ---I repeat --- thereby finally discover that we are most probably here for local information-gathering and local-Universe problem-solving in support of the integrity of eternally regnerative Universe.

The buildup of atmospheric carbon dioxide poses one of the most challenging problems that humanity has ever been faced with. Gaian evolution is "forcing our hand" so-to-speak. Peoples of the world must either acknowledge the magnitude and seriousness of the problem, lay down their arms, and join together in a world-around effort to replenish our soils or endure untold suffering.

If we choose to assist Gaia in her efforts to sustain her ecological integrity, the rewards will be great. Humans will discover the synergistic and precessional benefits that result from conscious cooperation. It would be impossible, after all, to mount such a massive global effort and support a nuclear arms race at the same time.

Nature, Einstein reminded us, is "subtle, but not malicious." She has given us a choice. That choice, summed up prophetically by Fuller is "utopia or oblivion."

GLOBAL CLIMATE/EARTH SYSTEMS MONITORING AND MODELING: AN INTERDISCIPLINARY EVALUATION

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2-15-86

ABSTRACT

Climate is a particularly important component of the earth system because of the short- to medium-term impacts of climatic change in diverse areas as: patterns of energy consumption, amount and distribution of arable land, agricultural productivity, and incidence of famine. In the longer-term, climatic change appears to have a key role in, for example, glacial cycles and changes in sea level.

Understanding climatic change requires an interdisciplinary approach because many other components of the earth system (e.g., oceans, ice mass) interact with climate. Information technology--such as remote-sensing satellites, data communication networks, computerized data centers, and the entire range of computer tools (from microcomputers to supercomputers)--now makes possible improved monitoring and modeling of the earth system, including climate. And over the last 5 to 10 years, research results have vastly increased the scientific knowledge base in most of the relevant disciplines (e.g., glaciology, geology, botany, oceanography, meteorology).

But to date, the necessary interdisciplinary monitoring, modeling, and analytical efforts have not taken place, in part because of the relative insulation of the various disciplines from one another. Much of the necessary earth systems data already is being collected but is not presently being compiled in an accessible, validated, useable format that includes key indicators of the atmosphere, oceans, glacial and volcanic cycles, land mass, and biota (plants, forests, etc.). Climate modeling has advanced rapidly in recent years. But the modeling results generally have not been evaluated from a broader earth systems perspective and compared with key earth systems indicators. Climate modelers are gradually adding more variables and details, but as yet even the most complex models (coupled atmosphere-oceans models run on supercomputers) have many major areas of uncertainty, such as: the role of clouds and sea ice, surface albedos (including snow, ice, land, vegetation), atmospheric turbidity (e.g., from volcanic eruptions and air pollution), and transient (as contrasted with steady-state) response.

This paper compiles and integrates available earth systems trend data and research results on a broadly interdisciplinary basis, compares these data with the results of major climate models and with available paleoclimatic data, and briefly considers the implications for future research strategies and public policies as they relate to the earth and climate systems.

*The views expressed are those of the author and not necessarily those of the OTA, Technology Assessment Board, or Congress.

2-1-86

A PLAN FOR SOCIAL ACTION IN REDUCTION OF ATMOSPHERIC CARBON DIOXIDE AND CLIMATE STABILIZATION

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ABSTRACT

According to Professor Aleksis Dreimanis of the International Quaternary Research Association we are in the interglacial/glacial transition, we should understand what is happening, the human role in the process, and should organize a global response.

The rising CO/2 level in our atmosphere relates to a more complex combination of phenomena than is generally recognized. The two major CO/2 processes at present are (1) the exponentially rising amount of CO/2 in the atmosphere due to burning of fossil fuels and (2) the exponentially rising level of CO/2 due to a collapse of the soil and tree sub-system (that normally absorbed CO/2) at the end of the present - interglacial period. Our planet has gone through 17 or more cycles of approximately 70,000 to 110,000 years of glaciation with about 10,000 years of interglacial warm period. The planet developed our present human civilization during this time, which is now coming to an end. The rising CO/2 triggers the deposits of more snow and ice on the poles leading to the glaciation. For our world economy to survive the threat of glaciation and the severe weather changes and drought that accompany the start of glaciation, we must begin a program of (1) reducing the burning of fossil fuels that add to the CO/2 and (2) massive reforestation, with remineralization of the soil, to restore the natural CO/2 eco-system.

An Earth Regeneration Program is global in nature. A 20 million job program for the United States, as part of international cooperation, is a reversal of the trend toward high technology jobs, service work and increasing permanently unemployed population. It means bringing to bear all possible labor in the next four years and maximum program for the following years until we know whether or not we are able to reverse the CO/2 buildup, move back from the current 345 parts per million in the atmosphere toward the 280 ppm of the interglacial period. This is the interaction of geophysics with economics, engineering and forestry. It is a shift to developing minority employment, full employment of labor resources, all those who need and are able to work. It means real attention to community survival priorities, educational and social. Alternative budget priorities include urban revitalization, soil-forest-energy work, job training or retraining and child care. This is technology and labor transition. It has its base in labor, management, and community participation. It is application of general systems analysis and planning on a scale never before needed or proposed.

Table 1

U. S. EMPLOYMENT PLAN — EARTH REGENERATION PROGRAM
Employment by Industry Group

	Employment, Thousands of Jobs				
	(1) 1984 Actual	(2) 1989 Estimate	(3) Trans-fer	(4) New Jobs	(5) Total Cols. (2) to (5)
Agriculture	2 958	2 920		540	3 460
Remineralization			1 000	5 000	6 000
Forestry and fishery	80	90			90
Reforestation			500	2 400	2 900
Mining	657	650	<300>		350
Rock for remineralization			100	50	150
Manufacturing	19 962	20 290	500	1 130	21 920
Durable manufacturing	11 858	12 050	500	690	13 240
Nondurable manufacturing	8 104	8 240		440	8 680
Transportation, communication and utilities	5 636	5 720		420	6 140
Transportation	3 209	3 230		180	3 410
Communications	1 397	1 440		170	1 610
Public Utilities	1 030	1 050		70	1 120
Wholesale and retail trade	23 976	24 200		1 330	25 530
Finance, insurance, and real estate	6 291	6 400	<100>	340	6 640
Services	24 296	24 920	<600>	1 320	25 640
Construction	5 927	6 100	1 000	4 820	11 920
Government enterprises	1 485	1 510		80	1 590
Special industries	1 615	1 700		90	1 790
Sub-Total	92 883	94 500	2 100	17 520	114 120
Government (federal, state and local)	15 760	16 400	<100>	1 890	18 190
Foreign participation				500	500
Military	2 100	2 100	<2 000>	90	190
Total	110 743	113 000	——	20 000	133 000

1984 Actuals (down to Sub-Total) are taken from the Bureau of Labor Statistics, June 1985, 155 sector tab run "Time-series date for input-output industries — output, price, and employment (1972-SIC definitions). The estimates are those of the author.

A HYPOTHESIS ON GEOPHYSICAL CYCLES, TECHNO-SOCIOLOGICAL EVOLUTION AND WORLD PEACE

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ABSTRACT

This is the concluding paper of a symposium of six papers on "Applying Systems Theory to the Problem of World Peace: A Case Study of Glacial Cycles and Climate Change." What are the prospects of both the U.S.A. and the U.S.S.R. developing cooperative concepts of dealing with the glacial cycle to cooperate on the project and to divert military personpower to working on the environment? The role of the Hamaker Thesis in the U.S.A. and the potential role of Moiseev's concept of "Coevolution with the Biosphere" in the U.S.S.R. are investigated for their possible contributions to world peace. The prospects of finding a viable constituency of people to work for peace are explored. Understanding of sociological cycles needed for effective shared coevolution are discussed and investigated. The role of understanding of geophysical cycles of glaciation in providing a psychological driving force for international cooperation is discussed.

For the U.S.A. and U.S.S.R. to develop a cooperative program for world peace there must be some impending danger such as the impending glacial period that poses a threat to both countries. In the preceding papers in this symposium we have established that the impending glaciation poses such a threat. We have learned that decision theory under uncertainty can help us minimize the maximum loss of human life. We have heard the geological evidence that we are moving into a glacial period, but we don't know with scientific certainty whether this is a little ice age or a full 90,000-year glacial period. We have learned that we have large data collection facilities and computer simulation services that could help us reduce the uncertainty of what is happening, if we could break the interdisciplinary boundaries. We have learned that there is a well thought out plan for trying to stop the glacial cycle by soil remineralization, reforestation, and reduction of fossil fuel burning.

If we do nothing until we have even further scientific information and the glacial period comes in accordance with predictions by Dreimanis, Schultz and Hamaker, will we regret that we failed to save two billion lives? Should we try to educate and convince Congress, the Department of Energy, the President, or who? In the U.S.S.R. do we try to convince the Communist Party leaders, trade union leaders, teachers or environmental groups?

A general systems analysis tied to the rate of scientific discoveries and inventions covers the epochs of force, power and communication. These epochs have apparent time spans as follows in which each epoch lasts an order of magnitude shorter then its predecessor: Force Epoch - 6000 years; Power Epoch - 300 years; Communication Epoch - 30 years; next undefined epoch - 3 years. Our present business and government organizations historically derived from a patriarchal prototype normally take about eight years to adapt to new concepts. There are indications that women's organizations can adapt to new concepts in about two or three years, which is closer to rate of change in society and nature. Therefore it requires that the

women of the world get on board to deal with the glacial cycle problems. We need to coordinate valuable features from ancient matriarchal societies, from the driving force from the present women's movements, and the residual valuable features of our patriarchal society, so as to arrive at a synthesis that shares in the coevolution with the biosphere.

There are many women's organizations active in the United States that could take on parts of the development of world peace. Three of them are the League of Women Voters, National Organization of Women, and the Women's International League for Peace and Freedom.

LIST OF MAIN PROJECTS for DEVELOPMENT
of COEVOLUTION with the BIOSPHERE

DECISION FACILITATORS:
[illegible] skill in aiding people [illegible] decisions when complete [illegible] is available. [illegible] of the risks [illegible] in [illegible] ing for complete [illegible] scientific proof are n- [illegible] for c[illegible] decisi[illegible] making.

EMERGENCY ACTION:
Development and carrying out emergency program such as remineralization and reforestation start-up.

SCIENTIFIC RESEARCH:
It is important that the basic research in the approximately 25 fields of science involved in understanding the climate and glacial cycles be accelerated, and that better communication be established between the different fields.

ENGINEERING SYNTHESIS:
The development of an adequate theory of climate change requires a synthesis of concepts from over 25 fields of science and the development of conceptual models and computer mathematical models of the climate and glaciation processes. The philosophy of general systems theory can help organize the material from the different fields of science provided there is some action linkage between the specialists in the different fields and the generalists.

PHILOSOPHICAL OVERSIGHT:
The services of philosophy professors are needed to check the completeness and validity of methods used to verify the computer simulation models used in climate research. As a starter, the procedures developed by the Society for Computer Simulation can be expanded to climate models.

EDUCATIONAL DEVELOPMENT:
To prepare the public and their representatives in Congress to deal with the glaciation cycles, we need to educate the public about the biosphere and its major components: the tectonic system, the oceans, the land, soil minerals, forest nutrition functions, photosynthesis, the atmosphere, the carbon cycle in the biosphere and a general tectonic-biospheric-atmospheric consciousness.