Edition 2.5 A
September 14, 1990

HANDBOOK FOR A SHAREABLE STRATEGY OF COEVOLUTION WITH THE BIOSPHERE

This update to the "Handbook for a Shareable Strategy of Coevolution with the Biosphere" has been issued to commemorate the completion of the first year of the World Emergency Campaign for Global Climatic Stabilization that was initiated in Cochabamba, Bolivia, in the summer of 1989. Information on the progress of the campaign in Bolivia can be obtained from Carlos Aliaga Uria, Casilla 3296, Cochabamba, Bolivia.

This Handbook is dedicated to the philosophy that (1) all possible alternative hypotheses to explain scientific data must be examined, in order to arrive at a most probable hypothesis to explain complex phenomena such as climate changes, and (2) to protect human civilization from geophysical catastrophes, we must use decision theory under uncertainty to evaluate the alternative choices of action when we have incomplete data and/or unproved theories.

Fred Bernard Wood, Ph.D., Editor

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in Cooperation with

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.: GREEN: PHILOSOPHY, ECONOMICS, EDUCATION, & ETHICS.	6: PINK: EMERGENCY ACTION
:: SALMON: SCIENTIFIC RESEARCH	7: WHITE: BIBLIOGRAPHY & INDEX
;: CANARY: STRATEGY & DECISION	
›: BLUE: ENGINEERING	

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HISTORICAL NOTE

SINCE 1956 EARTH SCIENTISTS HAVE KNOWN THAT OUR PLANET HAS BEEN IN AN ICE EPOCH FOR 2.4 MILLION YEARS AND THAT OUR PLANET GOES THROUGH NATURAL ICE-AGE CYCLES OF 70,000 TO 125,000 YEARS OF GLACIATION FOLLOWED BY 10,000 TO 12,000 YEARS OF WARM INTERGLACIAL PERIODS. THE SIGNS OF THE TRANSITION INTO THE NEXT GLACIAL PERIOD ARE ALL AROUND US. MANY OF THE CLIMATIC EVENTS PREDICTED TO ACCOMPANY THE TRANSITION ARE OCCURING, SUCH AS SHORTENED CROP GROWING SEASONS, UNUSUAL WEATHER DISTRUBANCES SUCH AS DROUGHT, EXTREMES OF HOT AND COLD, MORE TORNADOES, HEATING OF THE EQUATORIAL REGIONS, AND BEGINNING OF THE COOLING IN THE NORTHERN LATITUDES. IN 1974 CLIMATOLOGIST REID BRYSON ESTIMATED THAT THE CLIMATE CHANGES WOULD DISTURB OUR FOOD SUPPLY TO THE EXTENT THAT HALF A BILION PEOPLE MAY DIE OF STARVATION.

TO FULLY ASSESS THE IMPACT OF THE RISING ATMOSPHERIC CARBON DIOXIDE, WHICH IS MORE COMPLEX THAN THE SIMPLE GREENHOUSE EFFECT, IT IS NECESSARY TO COORDINATE INFORMATION FROM OVER TWENTY-FIVE SPECIAL FIELDS OF SCIENCE. SUCCESSIVE EDITIONS OF THIS HANDBOOK ARE PLANNED TO: (1) INDICATE OUR PROGRESS IN DEVELOPING A GENERAL SYSTEMS PERSPECTIVE OF THE CLIMATE PROBLEMS, AND (2) INDICATE A STRATEGY OF USING THE KNOWLEDGE WE ALREADY HAVE TO DEVELOP PLANS TO CHANGE THE CLIMATE CYCLE TO PROTECT THE FOOD SUPPLY FOR THE FIVE BILLION PEOPLE ON OUR PLANET.

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TABLE OF CONTENTS

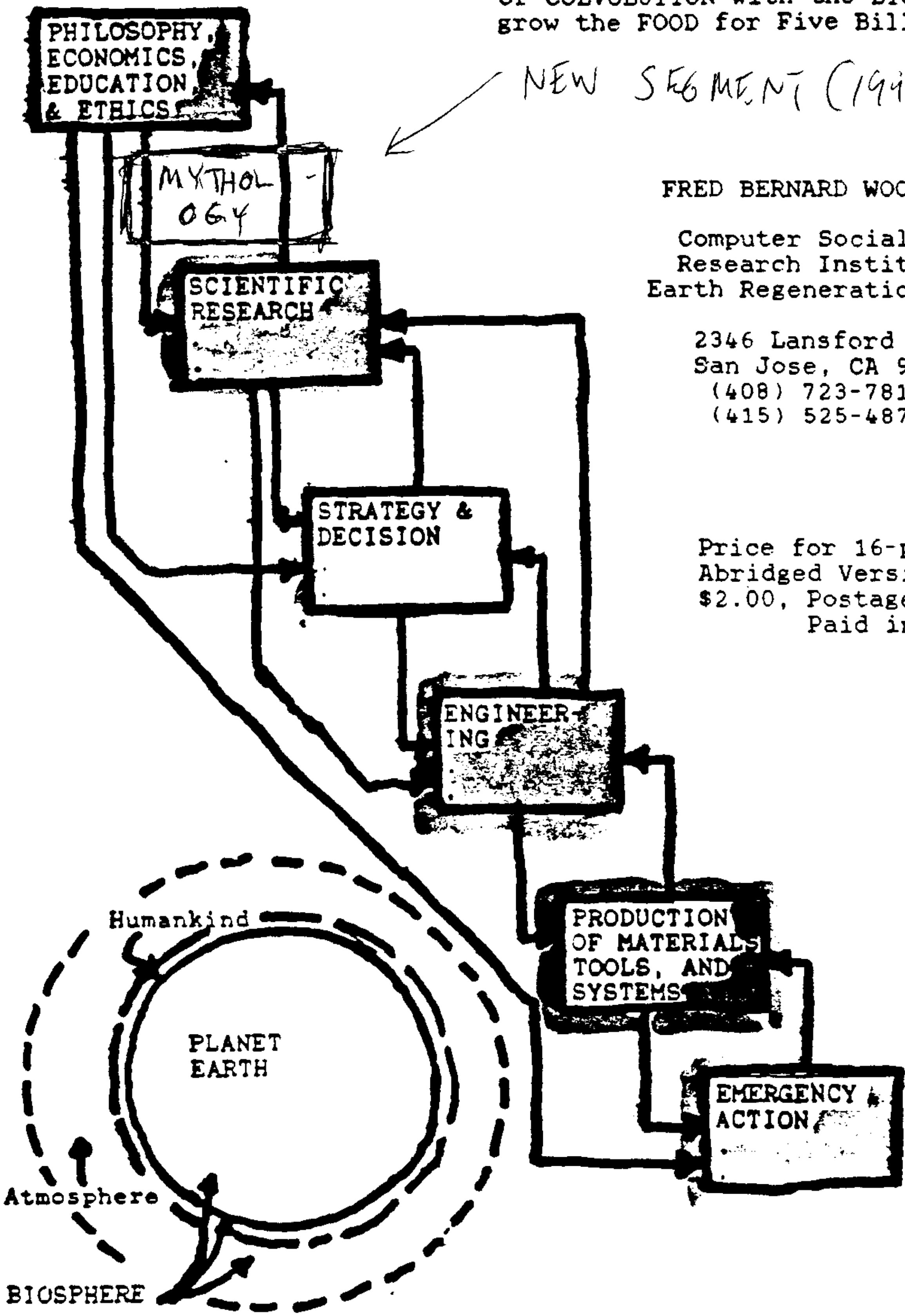
Space is reserved for a series of abridged versions of this handbook. One-page, four-page, and sixteen-page abridged versions are planned.

Pages 0-9 >> 0-10 are reserved for the one-page version.

Pages 0-11 >> 0-14 are reserved for the four-page version.

The sixteen-page version is included in this edition at pages 0-15 >> 0-32.

EARTH DAY 1989: OUTLINE for a SHAREABLE STRATEGY of COEVOLUTION with the BIOSPHERE to grow the FOOD for Five Billion People



FRED BERNARD WOOD, Editor

Computer Social Impact Research Institute and Earth Regeneration Society.

2346 Lansford Ave.
San Jose, CA 95125
(408) 723-7818
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Pages 1-2, 2A-2B, 3-16 are issued two ways:

(1) As a separate report: ERS #779 (CSIRI #A-1059-D),

(2) As an insert in the Introduction to the 80-page HANDBOOK issued as CSIRI #BE/A-950-F.

This report is a short version of a report that was issued with different colored paper for each of the six sections. This abridged report was prepared for printing on all white paper except the title page, which showed the titles of the six sections in colored blocks.

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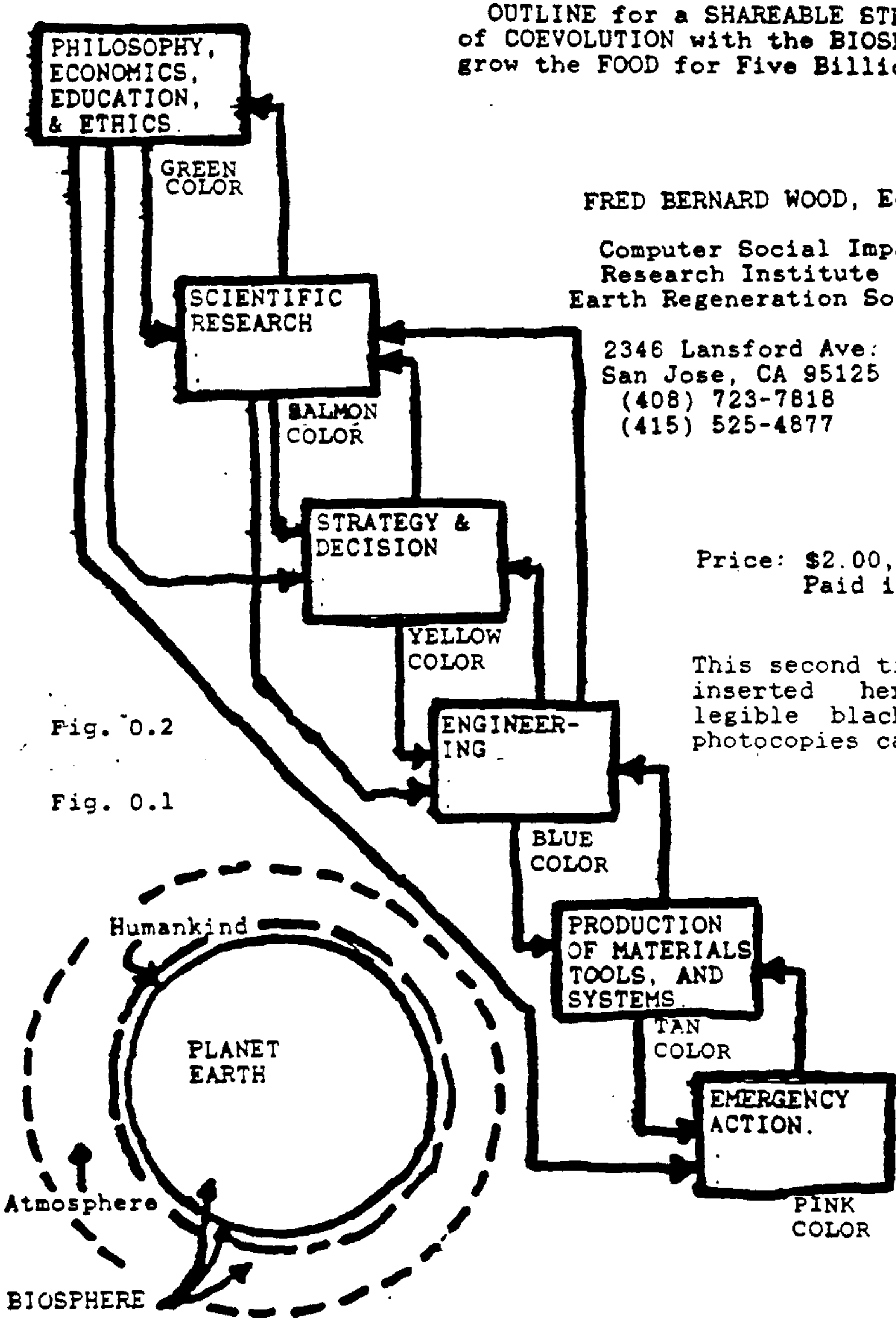


Fig. 0.2

Fig. 0.1

SECTION 1: PHILOSOPHY, ECONOMICS, EDUCATION, & ETHICS. GREEN COLOR

SHAREABLE: capable of being shared by women and men; by socialist and capitalist countries; by first, second, third and fourth world peoples; by differering religious groups; and by workers and managers.

COEVOLUTION: jointly, humankind together with nature working for a process of change in a certain direction, to protect the biosphere and the capability of supporting humankind.

When I compare the climate research done in the United States for the period 1977-1987 with the RADAR research and development done at M.I.T. Radiation Laboratory during the period 1941-1945, I find a number of things missing in the recent climate research, compared to the RADAR research a generation ago. At M.I.T. we would apply a completeness test to the problem and the mathematical method being used to verify that our mathematical series used could accurately represent the fields involved.

In the period 1941-45 the MIT Radiation Laboratory staff responded to the need for advanced RADAR systems to stop the Nazi bombing of England by semi-autonomous organization of scientists and engineers into separate but related functions. These functions are shown in the cover sheet of this report as:

Philosophy, Economics, Education, & Ethics
Scientific Research
Decision & Strategy
Engineering
Production of Materials, Tools, & Systems
Emergency Action

Many of the scientists left basic science research for the duration of the war and worked on important engineering and systems problems. We had a few professors of history and philosophy of science on the staff and the Technology Christian Associaton provided a meeting place for Radiation Laboratory staff members to meet for lunch or after work discussions of philosophical questions about the direction our civilization was going. When it became apparent that our industrial manufacturers couldn't move fast enough to produce some experimental airborne s-band radar fast enough, we set up Research Construction Co. to produce the pre-production sets. When General Electric Co. stalled on a one billion dollar order for SCR-584 Radars, we started preparation of plans for the U.S. Governement to seize General Electric Co. When GE Co. heard this and after I put on a demonstration of the microwave circuits for Pentagon Officers, GE Co. agreed to proceed with production of the SCR-584. The SCR-584's built by GE Co. were successful in shooting down the Nazi V-1 Rockets over England. (See NOVA Science TV Documentary "Echoes of War" 10/24/89)

We need a few scientists with the "zeitgeist" of the old World War II MIT Radiation Laboratory to review and overhaul the climate research program in the United States.

It appears that our recent climate research had generally ignored the glaciation cycle. Some paleoclimatologists and geologists have been warning us that our planet is nearing the end of the current interglacial warm period signalling the beginning of the next glacial period. In contrast, scientists on U.S. Government projects for the last ten years have concentrated on CO/2 induced greenhouse warming.

The present organization of scientific research doesn't seem to be able to put all the pieces together. The work doesn't integrate with the concept of "Co-Evolution with the Biosphere" developed by Academician N. N. Moiseev ("Coevolution: Some Propositions," 1984) and explored by Walter Truett Anderson (_To Govern Evolution,_ 1987). Use of general systems thinking as discussed by Peter Checkland (_Systems Thinking, Systems Practice,_ 1981) with John Platt's world problem priority tables and with Lovelock's "Gaia Hypothesis" leads to an improved perspective on the "Climate/Starvation" problem and a recognition of the possible connection through nutrition concepts to nine other major problems of our civilization.

This general systems approach overlaps with the concept of "Reconstructive Knowledge" developed by Raskin and Bernstein (_New Ways of Knowing,_ 1987) and leads to the splitting of research into six parts with feedback: Philosophical Oversight(incudingEconomics, Education, and Ethics); Scientific Research; Engineering Synthesis; Strategy & Decision Processes; Production of Materials, Tools and Systems; Emergency Action.

Steps are being taken to organize the International Geosphere-Biosphere Program (IGBP) to facilitate study of these problems by international teams of scientists (,). It is estimated that the IGBP will be fully organized by 1990 and substantial research results will be obtained by the year 2000. The U.S Department of Energy is conducting a research program on Carbon Dioxide and Climate ( ), and expects to complete an assessment of the impact of CO/2 by about 1990. The most comprehensive thesis on how the Biosphere functions is the Hamaker Thesis published in 1982, which predicted that 1984 was almost the last chance for humankind to stop the present shift to glaciation, with severe crop damage by 1990, and few people left alive by 1995. These dates are displayed on a time line in Fig 1.1 to illustrate how we may miss the last chance to do something about the glaciation and climate change if we wait for scientific certainty as to what is happening.

TIME LINE	IGBP International Geosphere-Biosphere Program	DOE U.S. Department of Energy, CO/2 Climate Research	Hamaker Thesis Predictions
		(continuation of earlier plans)	
1982			1982 Hamaker Thesis Published.
1983		1983 Research Plan	
1984			1984 Almost Last Chance to Stop Glaciation.
1985	1985 Program Proposed.	1985 State of the Art Papers.	
1986			
1987			
1988			
1989			
1990	1990 Program Organized .	1990 Assessment.	1990 Severe Crop Damage.
1991			
1992			
1993			
1994			
1995			1995 Few People Left Alive on Earth.
1996			
1997			
1998			
1999			
2000	2000 Analysis Completed.		

Fig. 1.1 Climate Research Time Lines and Worst Case Predictions.

Fig. 1.2 Checklist of Functional Subdivisions of the Problem of Climate Change Related to the Glacial Cycle, Tectonic Activity, Soil Demineralization, Dying Forests, & Rising Carbon Dioxide in the Atmosphere.

SHARED by MEN & WOMEN		COEVOLUTION with the BIOSPHERE
( )	( )	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 the climate models (21).

( ) ( ) EDUCATIONAL DEVELOPMENT:

To prepare the public and their representatves 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 atomosphere, the carbon cycle in the biosphere, and a general tectonic-biospheric-atmospheric consciousness.

( ) ( ) SCIENTIFIC RESEARCH:

It is important that the basic research in the approx. 25 fields of science involved in understanding the climate and glacial cycles be accelerated.

( ) ( ) ENGINEERING SYNTHESIS:

The development of an adequate theory of climate change requies a systhesis 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.

( ) ( ) DECISION FACILITATORS:

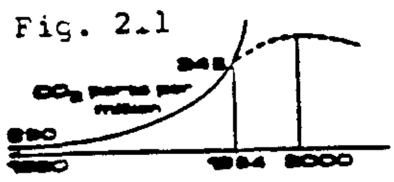
We need to develop people with skills in aiding people to make decisions where incomplete data is avaliable such that estimates of the risk involved in waiting for complete scientific proof.

Note added 12/27/89: For backgrounmd information on sharing of decision making by MEN and WOMEN, see the book: <u>The Chalice and the Blade</u> by Riane Eisler, San Francisco: Harper & Row (1987) and the xeroxed study guide, "The Partnership Way," Center for Partnership Studies, 20110 Rockport Way, Malibu, CA 90265, (213) 456-1441.

SECTION 2: **SCIENTIFIC RESEARCH** SALMON COLOR

Experimental Data on Glacial Ice Volume and Carbon Dioxide.

Fig. 2.1



ATMOSPHERIC CARBON DIOXIDE INCREASE AND PROPOSED REDUCTION

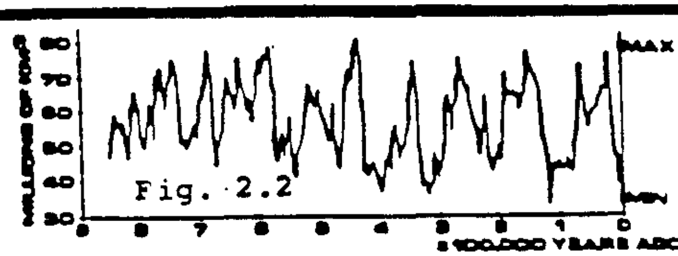


Fig. 2.2

VARIATION OF GLOBAL ICE VOLUME

Sec. 2.0 Basic Understanding of Glaciation Cycles

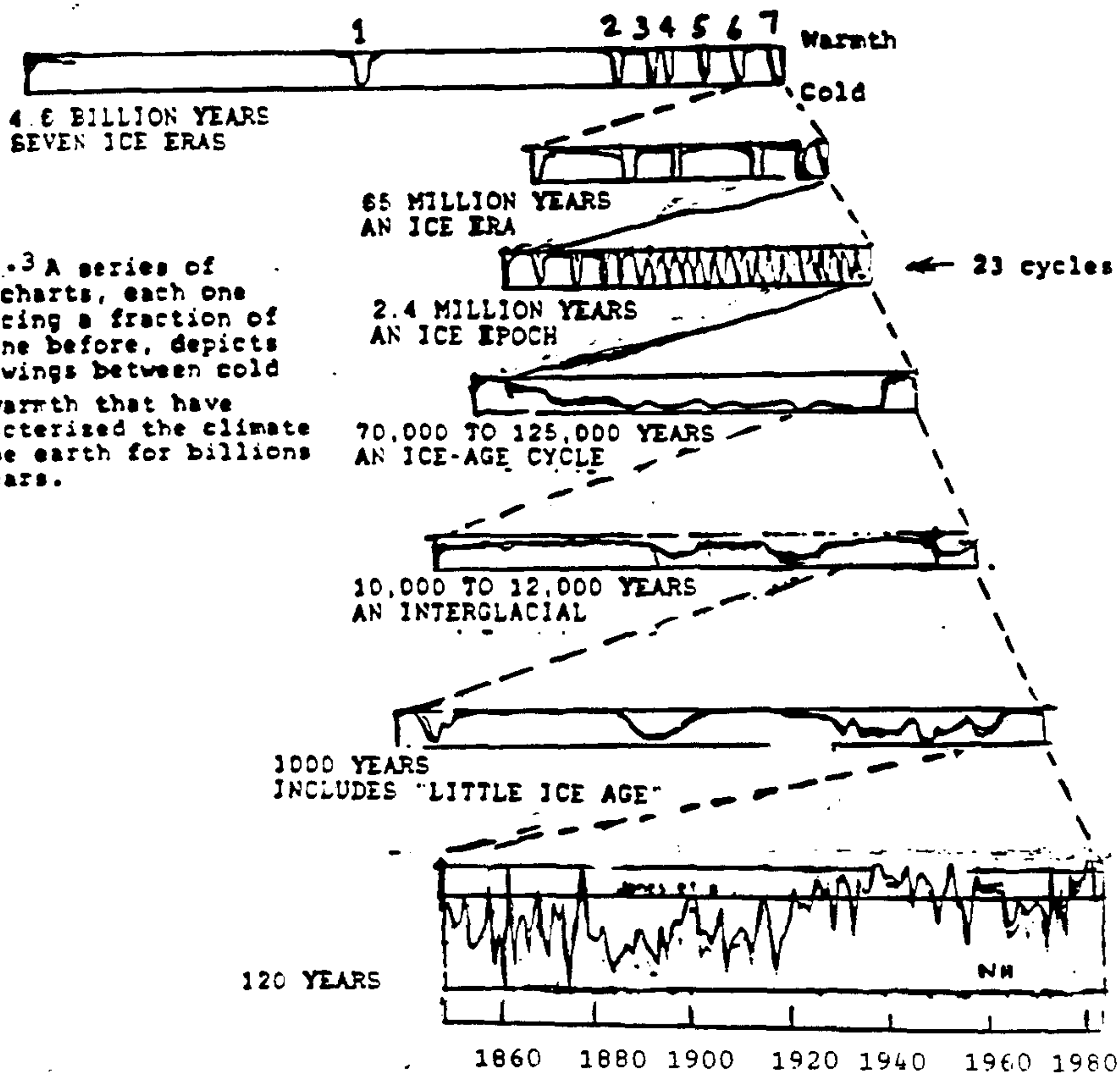
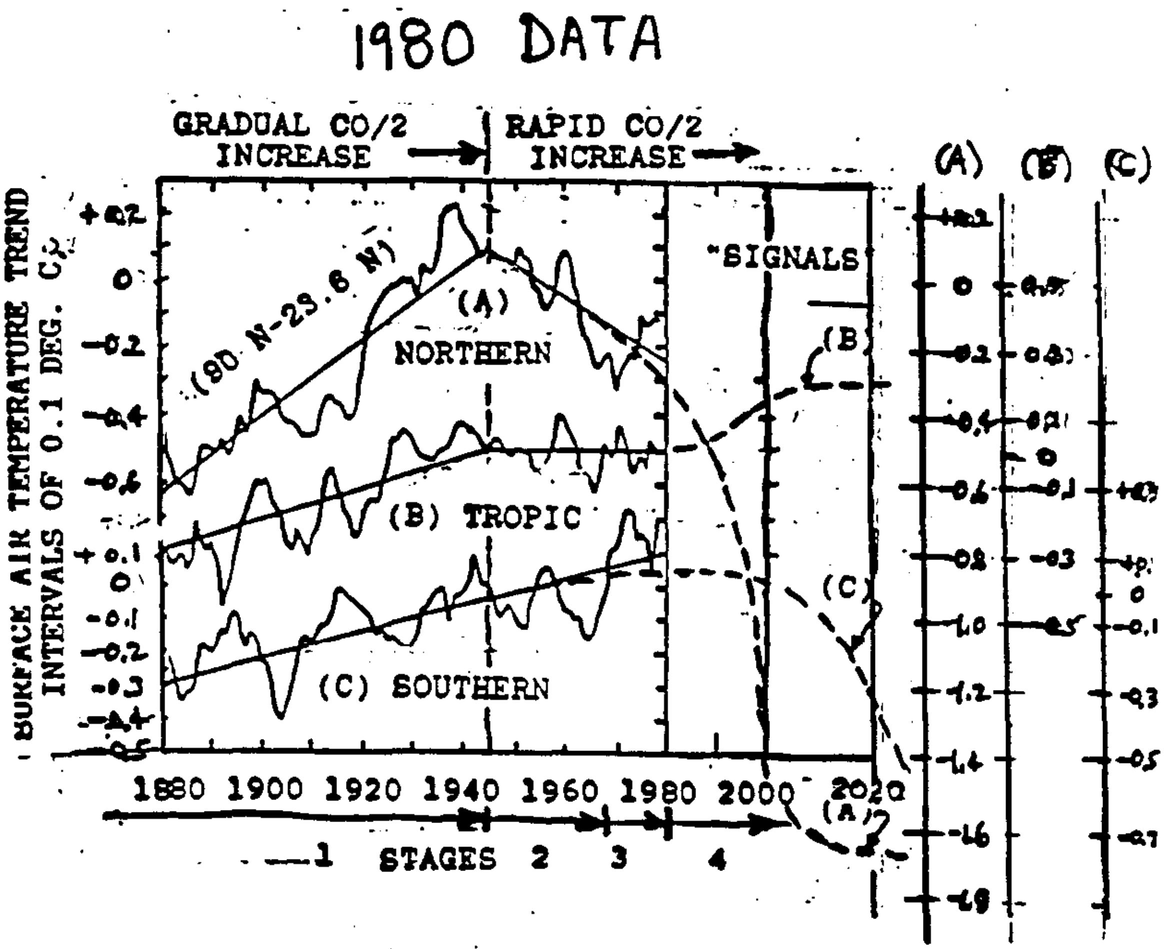


Fig. 2.3 A series of time charts, each one embracing a fraction of the one before, depicts the swings between cold and warmth that have characterized the climate of the earth for billions of years.

Expanded on next page to NORTHERN, TROPIC, and SOUTHERN lattitudinal regions.

Reference added 12/27/89: Windsor Chorlton and The Editors of Time-Life Books, Planet Earth: ICE AGES Alexandria, Virginia: Time-Life Books (1983), 176 pages, esp. pages 20-21.

Fig. 2.4 Hamaker's 1984 projection of the Arctic, Tropical, and Southern mean temperatures are shown as the dashed lines (A), (B), and (C).



TCS5 OZONE.LAYER 04/21/89

A bibliography on the ozone layer is being collected to facilitate clarification of where we stand on understanding the interaction between the destruction of the ozone layer by chloroflourocarbons, ultraviolet radiation impact on vegetation, and the glacial cycle. Priority is being given to understanding the glacial cycle, because if we miss the present opportunity to stop the glacial cycle, our next opportunity would come in 90,000 years. If we stop the release of all CFC's in the next five years it would be 100 years for the CFC's now in the upper atmosphere to dissipate. The CFC problem appears to more amenable to chemical research processes, while the glacial cycle problem is dependent on the natural photosynthesis process in the trees to remove carbon dioxide.

SECTION 3: **STRATEGY & DECISION** YELLOW COLOR

ALDEN BRYANT
470 Vassar Avenue, Berkeley, California 94708
(415) 525-4877

FORMAT AND DESCRIPTION FOR A CO/2 BUDGET

CO/2 Budget — soil, forest, energy work

Increase of CO/2	Grams of carbon input to the atmosphere: Current 12 month period	Future period
gasoline use	xxx	
oil use	xxx	
coal use	xxx	
natural gas use	xxx	
cutting trees	xxx	
soil deterioration	xxx	
natural disasters (1)	xxx	
Total	xxx	xxx

Reduction of CO/2	Grams of carbon removed from the atmosphere: Current 12 month period	Future period
Plant life		
forests (based on net growth rate)	xxx	xxx
swamps " "	xxx	xxx
grass lands " "	xxx	xxx
Soil		
soil remineralization, resulting in renewed and faster plant growth	xxx	xxx
Energy		
conservation (equivalent CO/2 reduction) [Range of energy conservation and fossil fuel offset activities]	xxx	xxx
alternative technology (equivalent CO/2 reduction) [Range of energy activities that will result in reduction of CO/2 output]	xxx	xxx
Total	xxx	xxx
Net effect on CO/2	xxx	xxx
Portion of global reduction of CO/2 required (This figure is more significant in the case of a state or country CO/2 Budget)		xxx

Insert Pg 9.25

(1) Combination of effects throughout the regional economy — from heat, drought, fires, floods, hurricanes, tornadoes, storms, feezing, and shorter growing seasons. Translate into terms of increase in CO/2 (direct and indirect) — fossil fuel use to recover from the disaster, loss of tree cover and alternative energy facilities.

[68-27 2-23-89]

Considerations for developing a CO/2 Budget

1. The world's forests, swamps, deltas, and grasslands are a major source of taking in carbon dioxide (CO/2) from the atmosphere. The oceans are also a CO/2 sink, but they change relatively slowly. The forests and swamps, and the soil they grow in, are the key to our efforts to stabilize climate.

2. CO/2 is the main driving force in the climate change. The increase (from less than 270 parts per million [ppm] in the atmosphere for about 120,000 years since the last change from interglacial to glacial conditions, to 350 ppm now) means an increased "greenhouse" effect. This increase produces more heat, drought, moisture evaporating in the lower latitudes, and more condensing, clouds, snow, and freezing in the higher latitudes, resulting in all-time record cold moving down from the north in the winter and sporadically in the summer as well.

3. The purpose of a CO/2 budget is to explain the balance between the CO/2 being put into the atmosphere, and the amount being taken out by forests and swamps, and how much is being offset by conservation and alternative energy development. This budget is a chart which indicates progress toward reducing CO/2 and achieving a stable level of approximately 270 ppm.

4. Climate stabilization means our effort to bring CO/2 back to the level that human society has known in the past, with a livable pattern of summers and winters and the ability to grow sufficient food.

5. We need to analyze the changes in industrial production, services and individual living patterns to bring about the necessary changes in soil, forest, and energy conditions.

6. One interesting problem is to show how much fossil fuel will be necessary to produce alternative energy technology, and to carry out soil and forest work.

7. We need to evaluate elements and sub-elements for the CO/2 Budget. This will require input from groups in the region involved with the activities included in the CO/2 Budget, such as mass transit and reforestation. How do these groups see the changes; and what will be their part in implementing the CO/2 Budget.

8. It is my goal to develop a sufficiently thorough base for information. The assumptions and calculations will have the broadest possible assistance from specialists in different disciplines, from public and private agencies, and citizen response throughout the areas concerned.

[69-1 2-23-89]

SECTION 4: ENGINEERING BLUE COLOR

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

John Hamaker, Mechanical Engineer
Rte. 1, Box 158
Seymour, MO 65746, 417/935-2116

Don Weaver, Ecologist, & Editor of
SOLAR AGE or ICE AGE? BULLETIN
138 Valdeflores Dr.
Burlingame, CA 94010, 415/342-0329

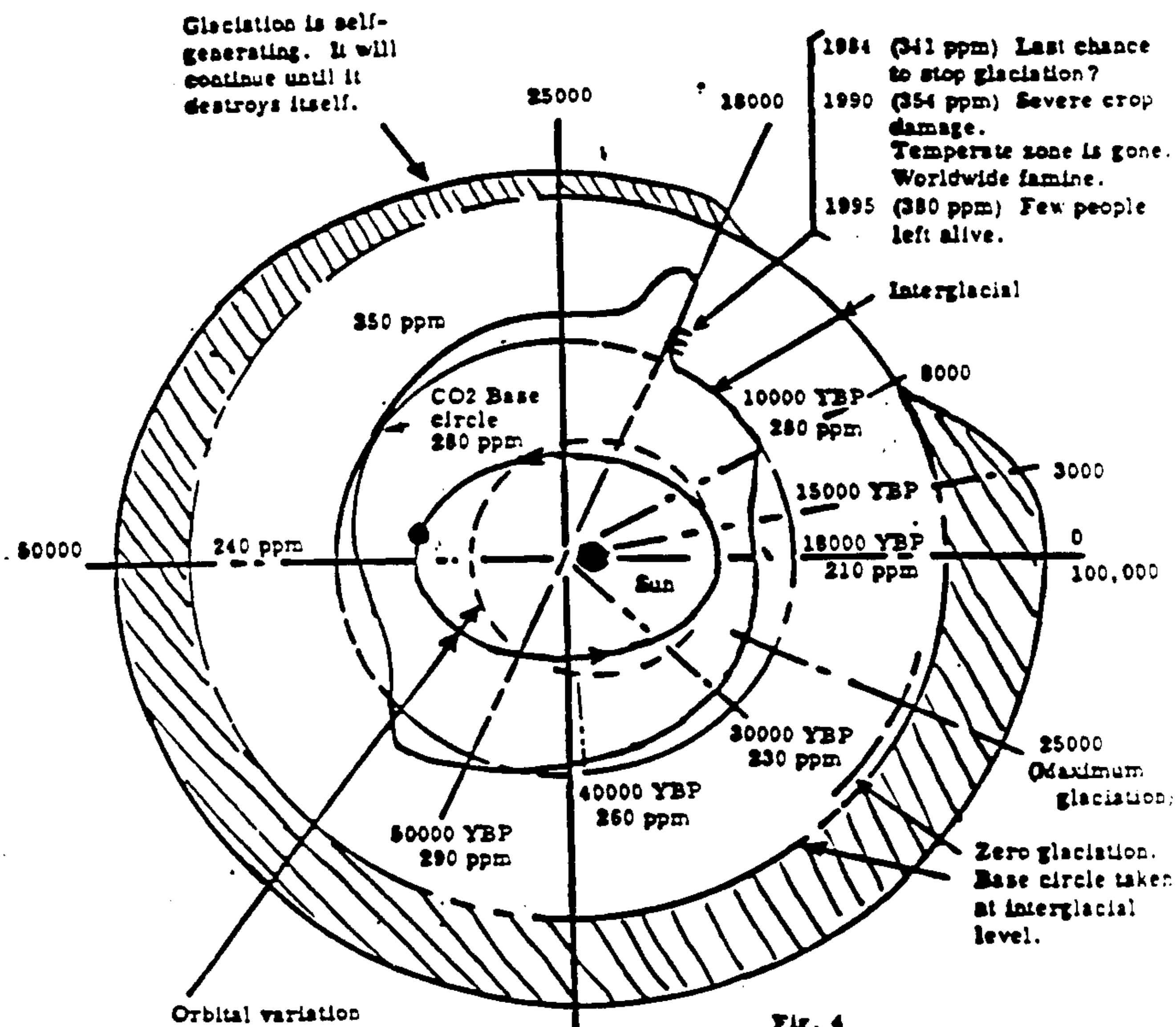


Fig. 4

TYPICAL GLACIAL CLIMATE CYCLE

SECTION 5: PRODUCTION OF MATERIALS, TOOLS, AND SYSTEMS.

Materials Needed to help reduce the carbon dioxide level in the atomosphere:

Rock dust for remineralization.

Tree seeds and seedlings.

Tools neded for the project:

Rock grinders to produce gravel dust.

Tree planting machines to speed up the reforestation work.

Systems needed to help in the work:

A method of computing carbon dioxide budgets for individuals, families, neighborhoods, cities, counties, states, countries, and the United Nations.

Computer simulation systems for analysing the climate system.

For information on rock dust and rock grinders see Soil Remineralization A Network Newsletter, 3 to 4 issues per year. Send $12 for subscription to:

SR
152 South Street
Northampton, MA 01060

For an outline of a carbon dioxide budget see page 9.
Further details available from :

Earth Regeneration Society
1442A Walnut Street, #57
Berkeley, CA 94709
(415) 525-4877

For a general reference on computer modelling of ecological systems, see:

Howard T. Odum, Systems Ecology New York City: Wiley-Interscience Publication, John Wiley & Sons (1983)

For information on the state of the art in computer simulation of climate, see:

A. Henderson-Sellers and K. McGuffie, A Climate Modelling Primer Chichester, England: John Wiley & Sons (1987)

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****************
*  EMERGENCY   *
*   ACTION     *
*              *
****************
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SECTION 6: EMERGENCY ACTION APPROACH: Development and carrying out emergency programs such as remineralization and reforestation to stabilize climate.

A SCORECARD TO HELP THE INDIVIDUAL ACCOUNT FOR HIS SHARE OF RESTORING THE EARTH AND DEVELOPING LEVERAGE WITH THE POLITICAL SYSTEM (Description on next page.)

A=North America B=South America C=Europe
D=Soviet Union E=China F=S.E. Asia
G=Africa

...	REFOREST-ATION	REMINERAL-IZATION	STOPPING FOSSIL FUEL BURNING	ALTERNATIVE ENERGY SOURCES	
UNITED NATIONS					A B C D E F G
NATIONS					A B C D E F G
MULTI-NATIONAL CORPORA-TIONS					A B C D E F G
STATES					A B C D E F G
INDIVIDUALS					A B C D E F G

It is proposed "SCORECARDS" be maintained to show how each group, by geographical location, level in the hierarchy, and segment of the problem is doing. If individuals and small groups do their proportionate part of say, reforestation, then they can put pressure upon the higher levels of organization to do their part.

WHAT ARE THE SOLUTIONS ?

mply, a full worldwide, maximum effort on earth regeneration program.

n earth regeneration program means:

** STOP DEFORESTATION

Forests are being destroyed at a rate uivalent to losing the size of the untry of Austria every year, and this te is increasing. This process releases rbon into the atmosphere and reduces the bility to balance CO/2 in the atmosphere rough photosynthesis.

* STOP BURNING FOSSIL FUELS. AND FIND NON NUCLEAR ALTERNATIVES

Coal, oil and gas, when burned, release O/2 into the atmosphere. CO/2 is being ut into the atmosphere through burning ossil fuels at an alarming rate.
uclear alternatives are not acceptable to his organization nor the health and elfare of the people of the world.

*** REFOREST AT THE RATE OF 500,000 SQUARE KILOMETERS OF NET GROWTH PER ANNUM FOR THE NEXT 30 YEARS.

To reduce CO/2, photosynthesis must be increased. A net increase in forest growth of 500,000 square kilometers for 30 years should pull enough carbon out of the atmosphere to return the CO/2 levels to well under 300 parts per million.

*** REMINERALIZE THE SOILS OF THE EARTH TO RESTORE THE HEALTH OF THE SOILS, SOIL ORGANISMS AND THEN THE TREES.

A glacial cycle remineralizes the soils over a long period of time. This is accomplished through glacier movements and wind blowing of glacial dust. Volcanic activity spreads minerals throughout the world. (Mt. St. Helens sent volcanic dust throughout the world as do all volcanoes.) Volcanic activity is greatly increased during a glacial period.

What must be accomplished is to artificially remineralize the earth. Not much rock dust per acre is needed. A number of countries and individuals in many more countries including our own, are already doing this on increasingly larger scales. This effort restores the mineral balance to the soils. This improves the survival ability of micro-organisms, the soils and consequently the trees.

- end

EARTH REGENERATION SOCIETY, INC.
1442A Walnut Street #57, Berkeley, California 94709
(415) 525-4877

March 21, 1989

Climate stabilization support activities

1. The California CO/2 Budget is due out in about four months. It can serve as a model for the U.S. and other countries. The structure is in terms of carbon (in atmospheric carbon dioxide, CO/2), showing annual CO/2 production and removal activities in a specified region. It is a jobs and environment program, relating to the drive to reduce CO/2 and stabilize climate.

2. Send letters to President Bush in support of the Emergency Climate Stabilization/Earth Regeneration Act of 1989, now in final preparation in the office of Representative Ronald V. Dellums. Ask the President to support this comprehensive legislation. There were a number of bills started in the U.S. Congress in 1988, all partially addressing the problem. Each state may have some legislation in the hopper — California has about a dozen bills started in 1988 or 1989, all touching on pieces of the action. One air quality control district has put out a very comprehensive requirement for an area in southern California.

3. Write to ERS for a copy of the Emergency Climate Stabilization/Earth Regeneration Act of 1989 if you wish to review the 11-page document.

4. See who in your state is interested in preparing CO/2 budgets — state, special district, county, city: legislators, local elected officials, organization members and leaders. ERS people may be available as consultants to assist with development of local CO/2 budgets.

5. Interested persons can study materials relating to climate stabilization, then take part in public meetings, writing for media, speaking on local radio and TV programs, and distributing pertinent materials.

6. For persons who wish to work more directly with ERS, we can suggest media people who should get letters and latest materials regarding the full climate cycle now under way, the emergency nature of the situation, and the extent of the program that is necessary. Send them a short cover letter suggesting that they look over the items you enclose and consider including some of the information in their writing or other forms of presentation: New York Times, Washington Post, local papers, TV and radio stations. We can send you a broad selection of material from which you can choose items for a particular media person.

7. There is a rising level of concern about climate change; but most of the stories present only pieces of the overall system and leave readers considerably uninformed or confused. It is our desire to assist with focus, clarity, and speed up of governmental and private action to stabilize climate through soil, forest, conservation and energy activities.

8. Encourage the use of good rock dust locally, with a broad range of minerals and trace minerals on trees in parks and forested areas (especially where trees are dying), landscaped areas, and food crops (to help avoid pesticides). Correspond with ERS regarding rock dust needs in the area and sources for adequate material.

9. Plant a tree, or two or ten or one hundred -- in remineralized soil as well as soil with organic additives.

10. Encourage conservation and alternative energy activities locally, including recycling.

11. Get publication lists from ERS and circulate copies to people who indicate they want to help develop the campaign for climate stabilization.

12. Financial input to the Earth Regeneration Society (ERS), to keep the work going at the fastest possible rate: subscribing member ($25), sponsoring member ($100); contributor to California CO/2 Budget (anywhere from smaller amounts for an individual to larger amounts for big companies). Contributors to the California CO/2 Budget will be shown in a special section following the Introduction. (We plan to produce a book of 100 to 150 pages.)

President George Bush. The White House. Washington, D.C. 20500

Representative Ronald V. Dellums. Room 2136, Rayburn House Office Building. Washington, D.C. 20515

[70-6 3-21-89]

Old Figure Numbers 4/22/89	New Figure Numbers 12/28/89
	0.1
	0.2
8	1.1
9	1.2
	2.1
	2.2
2.0	2.3
	2.4
4	4.1

PREFACE

First I will review the definitions of the words used in the title. Additions to the dictionary definitions are shown in parentheses.

WORDS IN TITLE	DICTIONARY DEFINITIONS
HANDBOOK for a	HANDBOOK: n. 1. a book capable of of being conveniently carried as a ready reference 2. a concise reference book covering a particular subject
SHAREABLE	SHAREABLE: adj. capable of being shared (by women and men; by socialist and capitalist countries; by first, second, third, and fourth world peoples; by differening religious groups; and by workers and managers)
STRATEGY of	STRATEGY: n. 1a(1): the science and art of employing the (geophysical, agricultural, nutritional, conservational, energy-wise), political, economic, psychological, and military forces of a nation or group of nations to afford the maximum support to adopted policies in peace or (not) war
COEVOLUTION with	CO - prefix 1: with: together: joint: jointly (here it means humankind together with nature) EVOLUTION: 1a: a process of change in a certain direction: UNFOLDING c(1): a process of continuous change from a lower, simpler, or worse to a higher, or more complex, or better state: GROWTH (xx: a process that may involve a thermodynamic cycle on the geophysical level to drive an unfolding process on the sociological level)
the BIOSPHERE	BIOSPHERE n. 1: that part of the world in which life can exist 2: living beings together with their environment

FRED BERNARD WOOD, Ph.D., Editor

WHY COEVOLUTION NOW?

Our planet is facing major climatic changes from two sources: (1) the natural glacial cycle, and (2) the increase of atomospheric carbon dioxide and other greenhouse gases by man-made processes. Some scientists think the man-made processes generating carbon dioxide will override the natural glaciation cycle, while others think that the man-made processes will accelerate the glaciation cycle. Whichever happens we will have catastrophic changes in agriculture leading to world-wide starvation.

We are at a stage in the evolution of our planet where we need to understand the climate processes so that we can make intelligent decisions about reducing the carbon dioxide level in the atomosphere, reforesting the earth, remineralizing the soil, and changing the glacial cycle. If we are going to change the glacial cycle we need to know what role the glaciation has in making it possible for life to continue on our planet so we can provide a substitute for the life-continuing features. The most comprehensive theory points to the glacial grinding of rocks into powder containing the minerals needed to replenish the topsoil.

First we need to know the history of the atmosphere and climate on our planet. Fig. 1 shows the approximate historical atmospheric composition of the atmosphere in percentages of hydrogen, nitrogen, carbon dioxide, and oxygen.

Fig. 2 shows the approximate variation of climate on our planet with an approximate scale of hot or cold in the earlier part and a more precise scale of degrees centigrade from normal for the bottom section for the last 120 years. Fig. 3 shows the temperature variations and trends for different latitudes of the earth.

> "Human beings have never experienced the earth's normal climate. For most of its 4.6 billion-year existence, the planet has been inhospitibly hot or dry and utterly devoid of glacial ice. Only seven times have major ice eras, averaging roughly 50 million years in length, introduced relatively cooler temperatures; humankind arose during the most recent of those periods."*

If the accidental anthropomorhic environmental impact is found to be making the environment worse, and insufficient scientific data on the process is available, then the COEVOLUTONARY step to take is to restore parameters such as carbon dioxide concentration, mineral content in soil, and quantity of trees on earth to known optimum historical values.

* Windsor Chorlton and The Editors of Time-Life Books, Planet Earth: ICE AGES Alexandria, Virginia: Time-Life Books (1983), 176 pages.

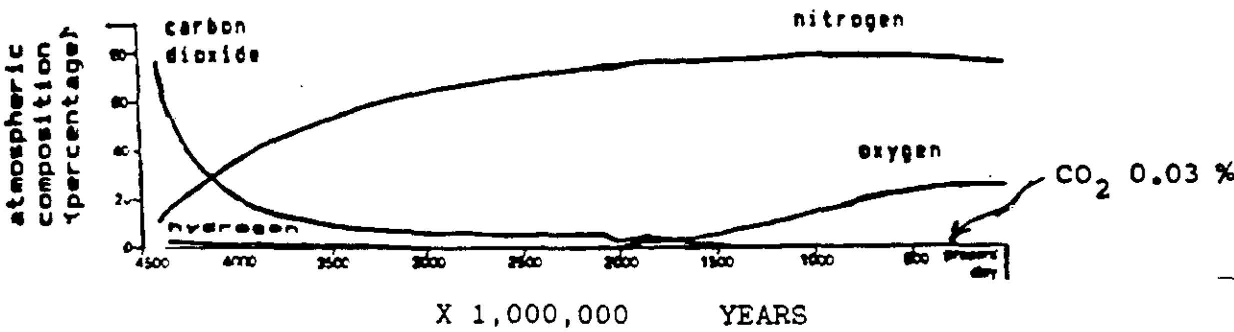


Fig. 1. APPROXIMATE HISTORICAL ATMOSPHERIC COMPOSITION.

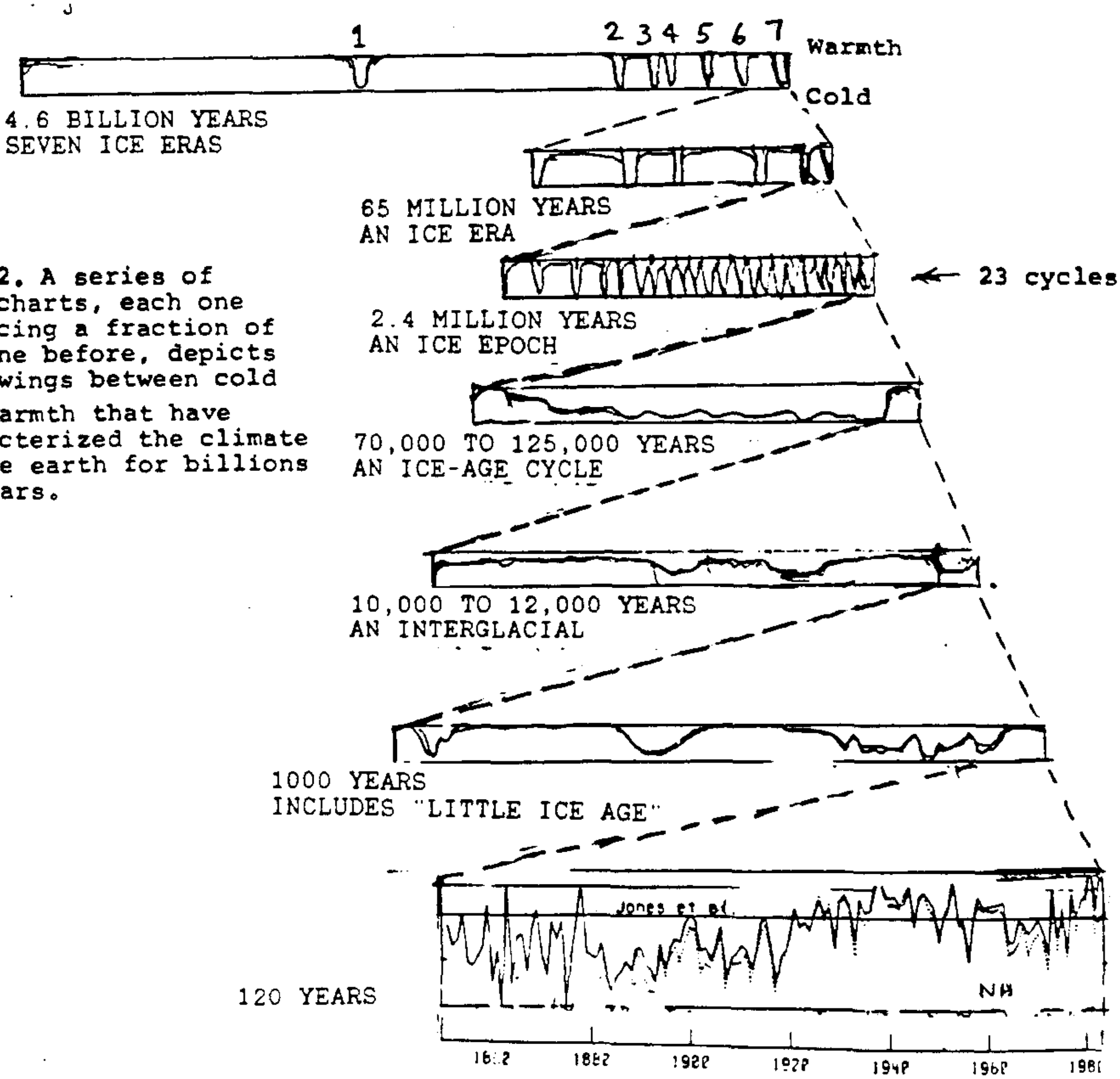


Fig. 2. A series of time charts, each one embracing a fraction of the one before, depicts the swings between cold and warmth that have characterized the climate of the earth for billions of years.

Fig. 3 illustrates the temperature variations and trends of the various latitudes of the earth.

Surface air temperature trend

in intervals of 0.1 deg. C

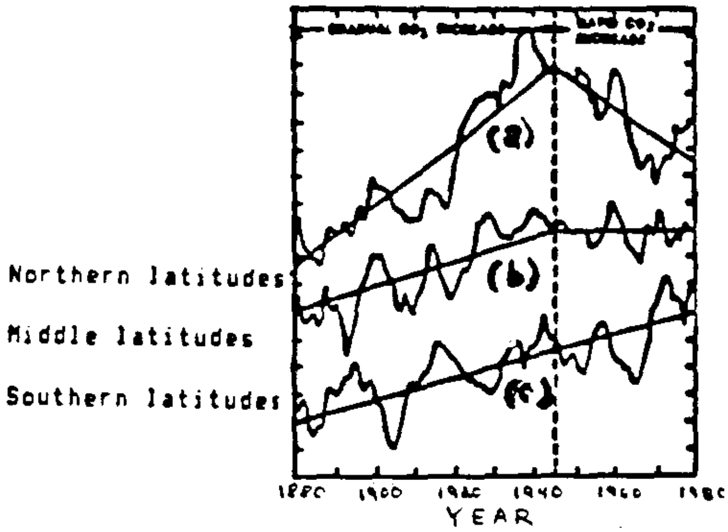


FIG. 3. NORTHERN, MIDDLE, AND SOUTHERN LATITUDE TEMPERATURE TRENDS.

In Fig.3 the Norhtern Latitudes average temoerature trend line (a) shows cooling from 1945 to 1980, while the the plot of annual temperatures (a) shows warming from 1970 to 1980. Another ten years of data will give a more accurate picture of whether it is really warming or cooling.

If the switch into the next glacial period is really coming soon, the changes in the food crop growing seasons will reduce the world's food supply from that suitable for five billion people to that suitable for only one or two billion people within ten years.

If we wait for scientific verification that we are going into glaciation it may be to late to change the glacial cycle. If we compare what should be done to slow down the greenhouse warming with what should be done to stop the glacial cycle, we find that for both events we need to reduce the level of carbon dioxide in the atmosphere. So let us proceed on plans to reforest the earth, stop destruction of the remaining forests, organize forest harvesting so that we plant more new trees that we harvest; reduce the burning of petroleum and coal; develop alternative energy sources such as solar energy; and deal with the world's nutrition problem by remineralizing the soil with man-made rock dust instead of waiting for the glaciers to grind up the rocks.

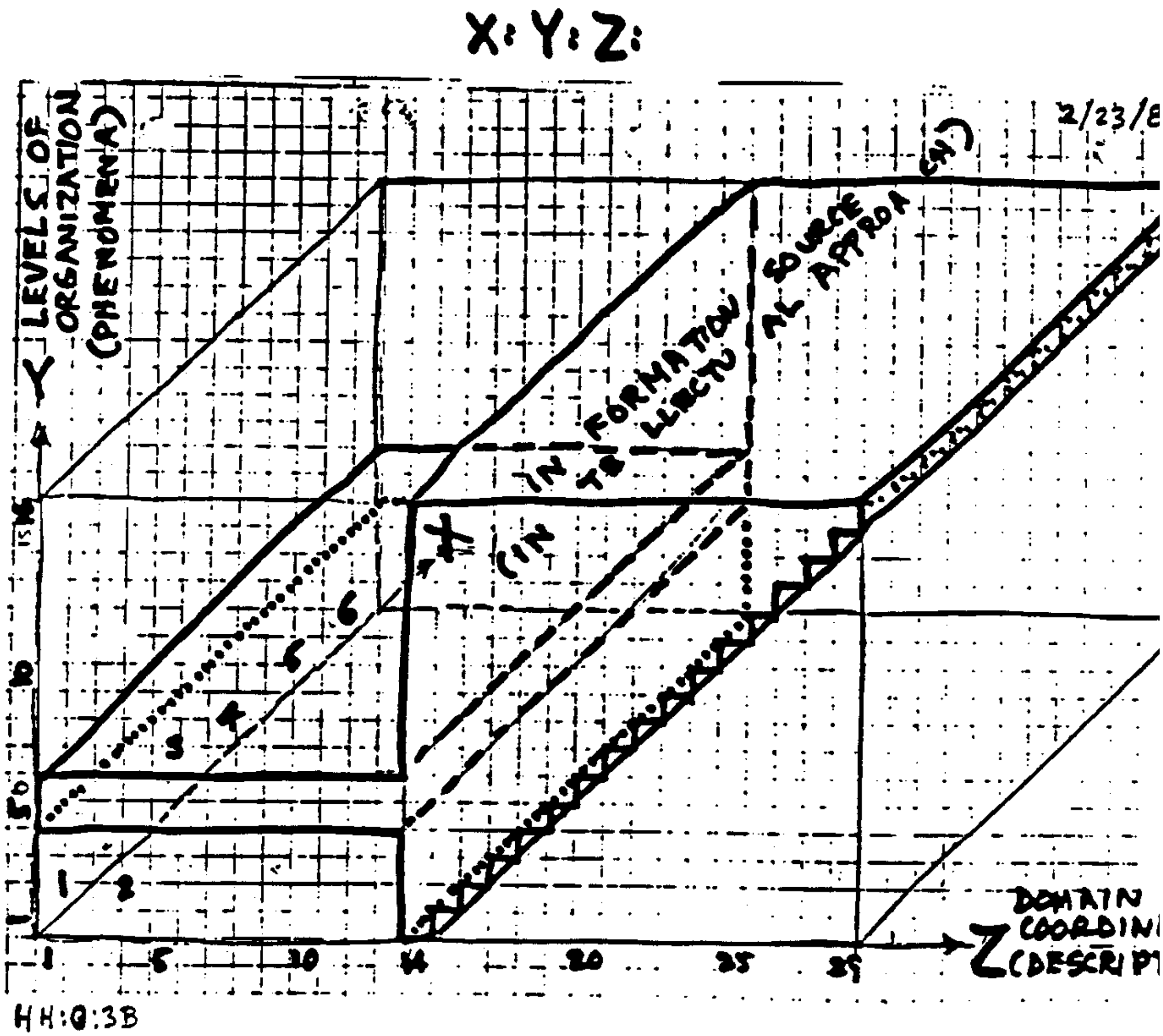
NOTE

Edition 1.1 was an experiment in bringing together material from the U.S. Department of Energy Carbon Dioxide December 1985 State-of-the-Art Reports and material from the International Society for General Systems Research May 1986 Philadelphia Meeting relating to the impact of the rising carbon dioxide on the Earth's glacial cycle. Edition 1.2 adds some material from ISGSR MEETING of 1987. Future editions are planned to add 1988 material and current litrature.

The coordinate system used to organize the papers is based upon one proposed at the 1979 SGSR Meeting in London, extended by the proposal at the National Audubon Society Expedition Institute, Amherst, Massachusetts, August 1985*. (* Audubon notes were in ON-LINE-MAGAZINE on a computer bulletin board, but have been archived. Paper copies can be obtained by sending a self-addressed stamped business size envelope to CSIRI, P.O. Box 5583, San Jose, CA 95150.)

PHILOSOPHICAL OVERSIGHT: Application of the philosophy of science and systems to check the completeness and validity of methods used to verify the computer simulation models used in climate research.

Sec. 1.0 Classification Coordinates Used in Quasi-Completeness Test.



FILE NO. A-950

COORDINATE SYSTEM FOR HANDBOOK

```
     Y LEVEL OF PHENOMENA                INTELLECTUAL APPROACH

                                                   X

     A                                          *
     !                                         /
     !                                        /
     !                                       /
     !                                      /

--------------------> Z DOMAIN COORDINATE
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Z	DESCRIPTION
1	BLACK HOLES
2	BOUNDARY LAYER
3	WHITE HOLES
4	GRAVITATION FLOW
5	GAS NEBULAE
6	CLUSTERS OF GALAXIES
7	GALAXIES
8	STAR CLUSTERS
9	STARS
10	ELEMENTS
11	COMETS
12	GASES
13	PLANETS
13.1	EARTH'S CORE
13.2	MANTLE/LAND
13.2.1	TECTONIC SYSTEM
13.2.2	MAGNETOHYDRODYNAMIC WAVES
13.2.3	SOIL MINERALS
13.2.4	VEGETATION
13.2.4.1	FORESTS
13.3	WATER
13.3.1	LIQUID WATER
13.3.1.1	OCEANS
13.3.1.2	RIVERS AND LAKES
13.3.2	SOLID WATER
13.3.2.1	POLAR ICE CAPS
13.3.2.2	GLACIERS
13.3.3	CLOUDS
13.4	ATMOSPHERE
13.4.1	CLIMATE

13.4.2	CARBON DIOXIDE
13.4.3	OTHER GRRENHOUSE GASES
13.4.4	OZONE
13.5	BIOSPHERE
13.6	NOOSPHERE
14	ENERGY
14.1	ENERGY FROM SUN
14.2	ENERGY FROM CORE
14.3	MATTER AND ENERGY FROM OUTER SPACE
15	ENTROPY/INFORMATION
16	CYBERNETIC FEEDBACK
17	STRUCTURE
18	BONDS BETWEEN ELEMENTS
19	GROWTH
20	METABOLISM
21	REPRODUCTION
22	DEPENDENCE OF SPECIES
23	LEARNING PROCESSES
24	INDIVIDUAL DEVELOPMENT
25	SYMBOLS AND LANGUAGE
26	ORGANIZATION
27	DIVISION OF LABOR
28	CENTRALIZATION/DECENTRALIZATION
29	GROUP INTERDEPENDENCE

Y	LEVEL OF ORGANIZATION
1	QUANTUM LEVEL
2	ELECTROMAGNETIC
3	PARTICLE
4	ATOMIC LEVEL
5	INORGANIC MOLECULES
5.1	GEOID SYSTEMS
5.2	PLANET EARTH
6	ORGANIC MOLECULES
7	PROTEINS
8	CELLS
9	MICRO-ORGANISMS
10	LIVING ORGANS
10.1	GAIA HYPOTHESIS
10.2	NUTRITION
11	INDIVIDUAL PSYCHOLOGY
12	FAMILY GROUPS
13	TRIBAL GROUPS
14	NATIONAL GROUPS
15	CORPORATE GROUPS
16	UNITED NATIONS

X	INFORMATION SOURCE	PRINT COLOR
1	PHILOSOPHERS	TAN
2	ENGINEERS	BLUE

3	SCIENTISTS	ORANGE
4	EDUCATORS	GREEN
5	DECISION MAKERS	GOLDENROD
6	ACTION PROGRAM	LILAC

Z'	SUPPLEMENTARY MATERIAL	
7	QUESTIONS	WHITE
8	UN-ORGANIZED MATERIAL	
9	BIBLIOGRAPHY	
10	INDEX	

Z"	SPECIALIZATION
E	EXPERTS
G	GENERALISTS
L	LAYPERSONS

THE PAGE AND PARAGRAPH NUMBERING IS BASED UPON THE SEQUENCE:

X:Y:Z:Es
X:Y:Z:Gs
X:Y:Z:Ls

WHERE "s" IS A SEQUENTIAL NUMBER

EVOLUTIONARY STREAMS (Y:Z-PLANE)

COSMOLOGICAL PROCESSES	Y:Z=5:1->5:14
PHYSICAL-CHEMICAL EVOLUTION	Y:Z=1:14->5:14
BIOLOGICAL EVOLUTION	Y:Z=5:14->10:20
CULTURAL EVOLUTION	Y:Z=10:20->15:25
TECHNOLOGICAL EVOLUTION	Y:Z=13:25->15:27
COEVOLUTION WITH THE BIOSPHERE	Y:Z=16:28

Section 1.1: A General Systems View of Agriculture, Climate and Glaciation.

X=1 (PHILOSOPHY) Y=5.1 (GEOID SYSTEM) Z=1 (Smallest value of Z, i.e. for BLACK HOLES, in set in document) G (document written or reviewed by generalist or abstracted from a generalist source.)

Fred Bernard Wood, Ph.D.(elec.engin.)
Computer Social Impact Research Institute
2346 Lansford Ave., San Jose, California 95125

General Systems Philosophy (a,b) points to a more general overview to make sure our analysis is as complete as possible. Traditional science looks at the narrowest possible sub-system of the pheomena being studied. The following diagram illustrates how modes of operation, levels of phenomena, evolutionary sub-systems, and cyclic sub-systems enter into the general systems study of a problem.

Scientists working in separate parts of the agriculture-climate-soil -glaciation- atmosphereic system say that separate parts such as the influence of carbon dioxide on glaciation have not been proved. Our approach in general systems theory is to try to find or develop a thesis or thematic-hypothesis that encompasses the total phenomena and then search for what experimental facts agree or disagree with the thesis.

In physics none of the basic theories have been proved. For example, Einstein's special theory of relativity relating electromagnetic theory to mechnaics is accepted, because all competing theses (theories) have inconsistencies with known experiments.

(1)MODES OF OPERATION	(2) LEVELS OF PHENOMENA(c) (Universe)	(3) LEVELS OF PHENOMENA(d) (Planet)	(4) EVOLUTIONARY SUB-SYSTEMS(d)	(5) CYCLICA SUB-SYSTEMS
Intuitive (b)	Black Holes	Supranational	Cultural Evolution	Sociologica
(right brain)	White Holes	Society(j)	Technological	Planetary
		Organization	Evolution	CO/2(e)
	Gas Nebulae	Group	Communication	Ice(e)
Empirical	Galaxy		Era	Weather
Science	Clusters	Organism(j)		Temperatur
	Galaxies	Organ	Power Era	Food Suppl:
Abstract				Astronomica
(left brain)	Star Clusters	Cell(j)	Force Era	
	Stars			
	Sun, energy			
	Normal			
	Sun-spots			
	Neutrinos			
	Nova?		Biological	GAIA
	Comets		Evolution	HYPOTHESIS
	Gravitation	Geoids		(h,i,k)
	Gases	Possible		
		Catastrophes(g)		
	Planets ---->	Atmosphere		
	Molecules	Oceans		
	Atoms	Land areas	Physical-Chemical	
	Sub Atomic	Crust	Evolution	
	Particles			
	Electromgntic	Tectonic System		
	Fields	Hydraulic		
	Tachyon	Pressure		
	Fields(x)			
	Quantum	Mantle, energy		
	Energy	Radioactive decay		
		Natural Nuclear		
		Reactors		
		Core	Cosmological	Cosmological
			Evolution	Cycles

In the table above, we have established five columns of categories to help us develop an overview of the problems of planet earth, in a way that helps us do as complete as possible coverage of all the phenomena involved.

In (1) MODES OF OPERATION we list three modes that must be coordinated in the analysis of a complex problem: Use of the intuitive -artistic -poetic functions of the right hemisphere of the brain in a relatively unconscious mode to develop thematic hypotheses; the observation and measurement of physical phenomena in Empirical Science to test both intuitive concepts from the right brain and abstract -logical hypotheses from the left brain; use of the abstract -logical features of the left hemisphere of brain to develop more conscious mathematically computable hypotheses. For a brief discussion of the functioning of right and left hemispheres of the brain see Bowler (ref b, pp. 97-99).

In (2) LEVELS OF PHENOMENA (Universe) we have listed a hierarchy of levels of mass/energy in the universe. The lower part of the column lists the hierarchy of energy/particles of chemistry and physics. In the upper part the different levels of objects in the universe ranging from planets to galaxies to black holes. Indented under sun are three levels of energy from the sun that may occur.

In (3) LEVELS OF PHENOMENA (Planet) the upper hierarchy is the levels of living systems on our planet, and the lower hierarchy repesents the layers of systems of the planet from the core out to the atmosphere. Under geoids are listed possible castrophes described by Asimov (ref g). Under tectonic systems the hydraulic pressure of the fluids in the mantle are noted. In addition to the hydraulic pressure there is energy from radioactive decay of atoms and also the possibility of natural nuclear reactors where a critical mass of U-235 accumulates. Naturally occuring nuclear fission reactors of 1.8 billion years ago are identified by the Sourcebook Project (ref. f).

In (4) EVOLUTIONARY SUB-SYSTEMS we start from the bottom with Cosmological Evolution and move up through Physical-Chemical, Biological, Technological, and Cultural Evolution. Technological Evolution is divided into three stages: force era, power era, and communication era. The Communication Era brought us the electronic computer-communications tools just in time for use in diverting the coming transition from an interglaical period to a glacial period.

In (5) CYCLICAL SUB-SYSTEMS we find sociological cycles in the philosophy of Hindus in India and the Hopi Indians in North America. The Hindu yugas have cycle period times that bear some resemblance to the time cycles of the glaical periods. The GAIA HYPOTHESIS states that the conditons of the earth's surface, oceans, and atmosphere will adjust to conditons for the maintenance of life on our planet. Hamakers's thesis is consistent with this in that over each 100,000 year cycle the amount of carbon dioxide in the atmosphere and the amount of ice in the glaciers adjust to replenish the soil so that plants can again grow on this planet after the topsoil is demineralized and otherwise dissipated. In order for the glaciers to grind and distribute gravel to make the new topsoil, a large part of the plants, animals, and humans may die as the glaciers advance, leaving a smaller population of living matter in the tropics. By Hamaker's thesis the increasing carbon doxide from our industrial society is accelerating the coming of the next glacial period.

In our review of the literature on agriculture-weather-carbon dioxide, none show explicit use of general systems theory. However the thesis of John Hamaker on carbon dioxide and glaciation shows the most complete coverage of the sub-systems that would be considered from a general systems point of view. John Hamaker's thesis comes close to satisfying the General Systems Approach of relating to the known facts in all the related fields of phenomena.

This general systems approach does have an element of incompleteness by reason of the analysis starting from the more general (or top-down) and going down into the more specific details. To make this analysis more complete, the next step is to get the experts in the approximately twenty fields of science involved to cooperate with each other to fill in the missing gaps in the research on carbon dioxide, weather, soil demineralization, and glaciation.

References:

(a) Ludwig von Bertalanffy, *General System Theory* New York: George Braziller (1968)

(b) T. Downing Bowler, *General Systems Thinking* New York: North Holland (1981)

(c) Ervin Laszlo, "Basic Constructs of Systems Philosophy," pp. 66-77 in Brent D. Rubin and John Y. Kim, *General Systems Theory & Human Communication*,Rochelle Park, NJ: Hayden Book Company (1975)

(d) Frederick Bernard Wood, "A Proposal for a Quasi-Completeness Test of General Systems Theories using Computer-Conferencing and Computer Data Base Searching Coordinated with a Public Museum Exhibit Space Structure," *Procedings of the Silver Anniversary International Meeting (SGSR),* London, England, Ausust 20-24, 1979, 164-173.

(e) John Hamaker, "The Climate Cycle Revealed - A Basis for Immediate Action," pp. 23-37 in *Solar Age or Ice Age? Bulletin* No. 4-5, Double Issue, December 1983, edited by Don Weaver, Hamaker-Weaver Publications, Box 1961, Burlingame, CA 94010.

(f) William R. Corliss, *Strange Planet -- A Sourcebook of Unusual Geological Facts*, Vol. E2, Glen Arm, Maryland (1978) entry ECN-008, "Nuclear Reactor in the Jungle," a report on naturally occuring nuclear reactors 1.8 billion years ago at sites of uranium mines in South Africa.

(g) Isaac Asimov, *A Choice of Catastrophes - The Disasters That Threaten Our World,*" New York: Fawcett Columbine (1981).

(h) J. E. Lovelock, *GAIA A new look at life on Earth,* Oxford: Oxford University Press (1979) p. 152, definition: Gaia Hypothesis: This postulates that the physical and chemical condition of the surface of the Earth, of the atmosphere, and of the oceans has been and is actively made fit and comfortable by the presence of life itself. This is in contrtast to the conventional wisdom which held that life adapted to the planetary

conditions as it and they evolved their separate ways.

(i) Eugene P. Odum, *Basic Ecology* Philadelphia: Saunders College Publishing (1983), 613 pp. Ch. 2, Sec. 4 "The Biological Control of the Geochemical Environment: The Gaia Hypothesis," pp. 24-28.

(j) James G. Miller, *Living Systems* New York: McGraw-Hill Book Co. (1978) 1102 pp. "The 19 critical subsystems of a living system" p. 3; "Structure and Process" pp. 51-87; "Hypotheses Concerning Living Systems" pp. 89-119; "Selected Major Components of Each of the 19 Critical Subsystems at Each of the Seven Levels of Living Systems" pp. 1028-1029.

(k) Peter Russell, *The Global Brain* - Speculations on the Evolutionary Leap to Planetary Consciousness. Los Angeles: J. P. Tarcher, Inc. (1983) 251 pp. "The Gaia Hypothesis" pp. 21-26; "General Living Systems Theory" pp. 27-31; "Humanity in Gaia" pp. 31-33.

(x) Hans Nieper, *Revolution in Technology, Medicine & Society*, A. Keith Brewer Science Library, Admiral Ruge Archives of Bio-Physics and Future Science, Richland Center, WI 53581, (1985).

TSG3.ERS.1E 01/22/84; Rev. 02/21/84 ; Rev. 03/18/84; Rev. 07/05/85; Part of "OR" A-737 07/17/85; Rev. 02/16/88 Rev. 02/24/88.

Section 1.2: A Hypothesis on Geophysical Cycles, Techno-Sociological Evolution and World Peace.

Fred Bernard Wood
Computer Social Impact Research Institute, Inc.
2346 Lansford Ave., San Jose, CA 95125 408/269-9327

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:
We need to develop people with skills in aiding people to make decisions where incomplete data is available. Estimates of the risk involved in waiting for complete scientific proof are needed for current decision 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.

International Society for General Systems Research, Meeting, June 1-5, 1987, Budapest, Hungary, Symposium: Climatic Change and Evolution of the Biosphere

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Sec. 1.3: PHILOSOPHY OF TESTING HYPOTHESES AND MATRIX OF CLIMATE THEORIES VS. EVIDENCE

Fred Bernard Wood, Ph.D.,
Computer Social Impact Research Institute, Inc,
2346 Lansford Ave., San Jose, CA 95125

Keywords:

biosphere	carbon dioxide
climate	evidence
glaciation	greenhouse effect
nutrition	philosophy

Abstract

Is the rising level of atmospheric carbon dioxide going to accelerate the coming of the next glacial period? How and when does the greenhouse effect take place, and what are the results? The philosophy here is to build a matrix in which columns contain the hypotheses and rows contain the experiments, observed data, computer simulation output, projected impacts, proposed solutions, and discrepancies. The method used by physicists to check the special theory of relativity is used as a guide. A quasi-completeness test is used to reduce the chance of overlooking important factors in the matrix columns. The objective of this organization of the hypotheses and data on the climate problem is to help people keep track of the many aspects of the Biosphere, so that we can estimate the range of probabilities of the different hypotheses being correct, and the impacts of different alternative policy decisions.

The three most discussed theories of climate change were analyzed against forty-six experiments and data. The SOIL NUTRITION GLACIAL CYCLE THESIS has the most agreements and no disagreements with reliable experimental data. The major hemispheric mean temperatures are marked with question marks, because of doubt about the corrections for urban heat island distortion.

PHILOSOPHY

Physicists often have to decide upon what competing scientific theory to use in their work, before they have a proof of which theory is correct.. For many years physicists have accepted Einstein's special theory of relativity on the basis of a matrix of rows of hypotheses and columns of experiments which showed that the special theory of relativity was the only theory that didn't have any disagreements with the experiments. (Ref. 1)

Here I shall report on an attempt to apply the same technique to the conflicting theories of climate change. Twelve competing theories have been identified. Forty-five experiments and data sets have been identified plus one significant philosophical principle, namely the GAIA Hypothesis. For a more convenient computer screen display of the matrix, the rows and columns for the climate case are reversed from the typical convention in physics. This is an incomplete analysis, in which the three most discussed hypotheses have been analyzed for agreement of disagreement with the forty-six experiments, data, or principles. These are tabulated in Figures 1a,1b.

The hypotheses are defined in the references indicated. For economy of space only major books and U.S. Department of Energy "State-of-the-Art Reports" are given full bibliographic reference data.

HYPOTheSES

A. CARBON DIOXIDE GREENHOUSE WARMING (REVELLE, BUDYKO) Ref. 8, pp. 307-308
B. SOIL NUTRITION GLACIAL CYCLE (HAMAKER) Hamaker Thesis in Refs. 6 & 12.
C. ASTRONOMICAL SOLAR ENERGY INPUT VARIATION (MILANKOVITCH, IMBRIE) Ref. 8, p. 265.
D. ASTRON. SOLAR INPUT VAR. & CO/2 FORCING (SHACKleTON, PISIAS) Ref 8, p.254, spectral analysis of O-18 isotope ratio.
E. 2500-YEAR LITTLE ICE AGE CYCLE (SHULTZ) SGSR 1986 Proc.
F. VARIABLE SOLAR OUTPUT (SIMPSON). Ref 8, p. 240.
G. LOW CO/2 BIO-CYCLE (MC ELROY AND OTHERS). REF. 9, pp. 33, 97.
H. VOLCANISM CYCLE & DUST (BRYSON, BROWNING) Ref. 8, p. 375, 523 (sub ref 19).
I. OPEN ARCTIC OCEAN.- Flohn considered period of 2.4 million ybp (Ref. 10, p. 241) as a possible analog of future CO/2 warmed earth.

J. ANTARCTIC ICE SURGE (DANSGAARD).- Ref. 8, p. 90, for antarctic ice surge at 90,000 ybp.

K. CONTINENTAL DRIFT & MOUNTAIN BUILDING (WORSLEY).- Not considered significant for present time era, but simulation of such processes in Paleozoic Era helps us understand how to simulate recent tectonic processes.

L. SNOBLITZ (FLOHN, HAYS).- See evidence for a snoblitz in Dansgaard's Greenland ice core at 89,000 ybp, Ref. 8, p. 88-89.

M. SUPER INTERGLACIAL (IMBRIE).- The rising CO/2 was supposed to go up to double and back down again within a hundred years period, see Ref 8, p. 491 (sub ref 26).

N. OTHER PROCESSES.- Other processes such as the Sun going into short nova, or a shift of the Earth's rotational axis have been mentioned in the literature, but are not included in this study.

EXPERIMENTAL DATA

(1) MEAN GLOBAL LAND SURFACE AIR temperature.- Ref. 8, p. 275; Ref. 13, p. 257.

(2) MEAN REGIONAL LAND SURFACE AIR TEMP..- Ref. 8, p. 275.

(3) MEAN TROPOSPHERIC & STRATOspheric AIR TEMP..- Wigley in Ref. 11, pp. 54-90.

(4) RURAL AIR SURFACE TEmperatures.- Watt, Kenneth E.F. "The effect of local influences on the perception of climatic trends," unpublished report, U.C. Davis, July 27, 1985.

(5) FOREST DETERIORATION.- Ref. 13, pp. 101-102, 124; Misc. refs. in SAIA?Bulletin (supplements to Ref. 6)

(6) CARBON DIOXIDE & ICE HISTORY.- Schakleton in Ref. 9, p. 32.

(7) EXPERIMENTAL HEATING REFRIGERATION CYCLE.- Simpson in Ref. 8, p. 240 and Supplements to Ref. 6.

(8) EXPERIMENTAL RESPONSE OF COLD TREES TO REMINERALIZATION.- <u>REMINERALIZATION NEWSLETTER</u> , 152 South St., Northampton, MA 01060; <u>SOLAR AGE or ICE AGE? BULLETIN</u> , 138 Valdeflores Dr., Burlingame, CA 94010.

(9) ATMOSPHERIC CARBON DIOXIDE.- Ref 9, p. 32.

(10) CLOUD COVER.- Ref. 8, p. 216 for principles; insufficient data.

(11) TORNADO ACTIVITY.- Data complete up to 1979.

(12) PREVAILING WIND PATTERNS.- Ref. 4, pp. 81-139.

(13) TREE & FOREST COVER.- Ref. 9, pp. 123-125.

(14) AGRICULTURAL LAND USE.- Ref. 9, p. 128.

Figure 1a. Table of Hypotheses (Columns) vs. Experiments (Rows) on Climate Cycle.

Legend:

"A" = Hypothesis agrees with experiment
"D" = Hypothesis diagress with experiment
"N" = Hypothesis not appicable to experiment
"?" = Insufficient experimental data
"." = Case not investigated yet

HYPOTHESES:

A. CARBON DIOXIDE GREEN-HOUSE WARMING
B. SOIL NUTRITION GLACIAL CYCLE
C. ASTRONOMICAL SOLAR ENERGY INPUT VARIATION
D. ASTRON. SOLAR INPUT VAR. & CO/2 FORCING
E. 2500-YEAR LITTLE ICE AGE CYCLE
F. VARIABLE SOLAR OUTPUT
G. LOW CO/2 BIO-CYCLE
H. VOLCANISM CYCLE & DUST
I. OPEN ARCTIC OCEAN
J. ANTARCTIC ICE SURGE
K. CONTINENTAL DRIFT & MOUNTAIN BUILDING
L. SNOBLITZ
M. SUPER INTERGLACIAL

EXPERIMENTS		A	B	C	D	E	F	G	H	I	J	K	L	M	
** MEAN GLOBAL LAND SURFACE AIR TERMPERATURE	1>	A	?	.	.	?	.	.	.	.	.	.	.	.	<1
** MEAN REGIONAL LAND SURFACE AIR TEMP.	2>	?	?	.	.	?	.	.	.	.	.	.	.	.	<2
** MEAN TROPOSPHERIC & STRATOPHERIC AIR TEMP.	3>	?	?	.	.	?	.	.	.	.	.	.	.	.	<3
** RURAL AIR SURFACE TERMPERATURES	4>	D	A	.	.	A	.	.	.	.	.	.	.	.	<4
** FOREST DETERIORATION	5>	N	A	.	.	A	.	.	.	.	.	.	.	.	<5
** CARBON DIOXIDE & ICE HISTORY	6>	?	A	A	A	A	.	.	.	.	.	?	.	.	<6
** EXPERIMENTAL REFRIGERATION CYCLE	7>	?	A	.	.	A	.	.	.	.	.	.	.	.	<7
** EXPER. RESP. OF COLD TREES TO REMINERALIZATION	8>	N	A	.	.	A	.	.	.	.	.	.	.	.	<8
** ATMOSPHERIC CARBON DIOXIDE	9>	A	A	.	.	?	.	.	.	.	.	.	.	.	<9
**. CLOUD COVER	10>	?	A	.	.	A	.	.	.	.	.	.	.	.	<10
** TORNADO ACTIVITY	11>	A	A	.	.	A	.	.	.	.	.	.	.	.	<11
** PREVAILING WIND PATTERNS	12>	A	A	.	.	A	.	.	.	.	.	.	.	.	<12
** TREE & FOREST COVER	13>	.	A	.	.	A	.	.	.	.	.	.	.	.	<13
** AGRICULTURAL LAND USE	14>	.	A	.	.	A	.	.	.	.	.	.	.	.	<14
** WILDLIFE MIGRATORY PATTERNS	15>	D	A	.	.	A	.	.	.	.	.	.	.	.	<15
** ORGANISMS IN OCEAN	16>	.	?	.	.	?	.	.	.	.	.	.	.	.	<16
** TOPSOIL AND SOIL MINERALS	17>	N	A	.	.	?	.	.	.	.	.	.	.	.	<17
** SOIL MICRO-ORGANISMS	18>	N	A	.	.	?	.	.	.	.	.	.	.	.	<18
** VARIANCE IN SOLAR OUTPUT	19>	.	.	.	.	.	.	.	.	.	.	.	.	.	<19
** ORBITAL CHANGES & ASTRONOMICAL CYCLES	20>	.	A	.	.	A	.	.	.	.	.	.	.	.	<20
** RADIACTIVE DECAY	21>	.	.	.	.	.	.	.	.	.	.	.	.	.	<21
** NATURAL NUCLEAR FISSION REACTORS	22>	.	A	.	.	?	.	.	.	.	.	.	.	.	<22
** MEAN GLOBAL SEA SURFACE TEMP.	23>	A	?	.	.	?	.	.	.	.	.	.	.	.	<23
		A	B	C	D	E	F	G	H	I	J	K	L	M	

Figure 1b. Table of Hypotheses (Columns) vs. Experiments (Rows) on Climate Cycle.

Legend:

- "A" = Hypothesis agrees with experiment
- "D" = Hypothesis diagress with experiment
- "N" = Hypothesis not appicable to experiment
- "?" = Insufficient experimental data
- "." = Case not investigated yet

HYPOTHESES:

- A. CARBON DIOXIDE GREEN-HOUSE WARMING
- B. SOIL NUTRITION GLACIAL CYCLE
- C. ASTRONOMICAL SOLAR ENERGY INPUT VARIATION
- D. ASTRON. SOLAR INPUT VAR. & CO/2 FORCING
- E. 2500-YEAR LITTLE ICE AGE CYCLE
- F. VARIABLE SOLAR OUTPUT
- G. LOW CO/2 BIO-CYCLE
- H. VOLCANISM CYCLE & DUST
- I. OPEN ARCTIC OCEAN
- J. ANTARCTIC ICE SURGE
- K. CONTINENTAL DRIFT & MOUNTAIN BUILDING
- L. SNOBLITZ
- M. SUPER INTERGLACIAL

EXPERIMENTS		A	B	C	D	E	F	G	H	I	J	K	L	M	
** MEAN GLOBAL SEA SUBSURFACE TEMPS.	24>	?	?	.	.	?	.	.	.	.	.	.	.	.	<24
** RELATIVE SEA LEVEL	25>	?	?	.	.	?	.	.	.	.	.	.	.	.	<25
** SEA WATER SALINITY AND DENSITY	26>	?	?	.	.	?	.	.	.	.	.	.	.	.	<26
** SEA ICE	27>	?	?	.	.	?	.	.	.	.	.	.	.	.	<27
** SNOW COVER	28>	?	A	.	.	A	.	.	.	.	.	.	.	.	<28
** PERMAFROST	29>	D	A	.	.	A	.	.	.	.	.	.	.	.	<29
** LAND ICE	30>	?	A	.	.	A	.	.	.	.	.	.	.	.	<30
** MOUNTAIN GLACIERS	31>	.	A	.	.	A	.	.	.	.	.	.	.	.	<31
** PRECIPITATION	32>	.	A	.	.	A	.	.	.	.	.	.	.	.	<32
** LAKE LEVELS	33>	.	A	.	A	A	.	.	.	.	.	.	.	.	<33
** PLATE TECTONIC ACTIVITY	34>	.	A	.	.	A	.	.	.	.	.	.	.	.	<34
** EARTHQUAKE ACTIVITY	35>	.	A	.	.	A	.	.	.	.	.	.	.	.	<35
** VOLCANIC ACTIVITY	36>	.	A	.	.	A	.	.	.	.	.	.	.	.	<36
** MINI-MICRO SIMU-LATION SUB-SYST.	37>	.	.	.	.	.	.	.	.	.	.	.	.	.	<37
** BLOCK SIMULATION OF MAIN CLIMATE LOOPS	38>	.	.	.	.	.	.	.	.	.	.	.	.	.	<38
** DETAILED SIMULATION OF COMPLETE SYSTEM	39>	A	.	.	.	.	.	.	.	.	.	.	.	.	<39
** CROP LOSSES	40>	.	A	.	.	A	.	.	.	.	.	.	.	.	<40
** LOSS OF HUMAN LIFE	41>	.	.	.	.	.	.	.	.	.	.	.	.	.	<41
** HUMAN MIGRATION PROBLEMS	42>	.	.	.	.	.	.	.	.	.	.	.	.	.	<42
** PROPERTY LOSSES	43>	.	.	.	.	.	.	.	.	.	.	.	.	.	<43
** STATE OF MINERALS IN SOIL	44>	.	A	.	.	?	.	.	.	.	.	.	.	.	<44
** MINERAL CONTENT OF FOOD CROPS	45>	.	A	.	.	?	.	.	.	.	.	.	.	.	<45
** CONSISTENT WITH GAIA HYPOTHESIS	46>	?	A	.	.	?	.	.	.	.	.	.	.	.	<46
		A	B	C	D	E	F	G	H	I	J	K	L	M	

(15) WILDLIFE MIGRATORY PATTERNS.- Schultz in SGSR 1986 Proc.
(16) ORGANISMS IN OCEAN.- Ref. 9, p. 95-97.
(17) TOPSOIL AND SOIL MINERALS.- Ref. 6.
(18) SOIL MICRO-ORGANISMS.- Ref. 6.
(19) VARIANCE IN SOLAR OUTPUT.- Ref. 2, pp. 440-464.
(20) ORBITAL CHANGES & ASTRONOMICAL CYCLES.- Ref. 8, pp. 265-269.
(21) RADIOACTIVE DECAY.- "The energy budget of the earth" in Cambridge Encyl. of Earth Sciences (1982)
(22) NATURAL NUCLEAR FISSION REACTORS.- Strange Planet, Vol. E-2, Section ECN-008, Glen Arm, MD (1978).
(23) MEAN GLOBAL SEA SURFACE TEMP..- Ref. 11, pp. 96-101.
(24) MEAN GLOBAL SEA SUBSURFACE TEMPS..- Ref. 11, pp. 100-101.
(25) RELATIVE SEA LEVEL.- Ref. 11, pp. 104.
(26) SEA WATER SALINITY & DENsiTY.- Ref. 11, pp. 101-104.
(27) SEA ICE.- Ref. 10, pp. 152; Ref. 8, p. 178.
(28) SNOW COVER.- Ref, 8, pp. 181-182.
(29) PERMAFROST.- Letter from Victor Kovda, Acad.Sci.USSR
(30) LAND ICE.- Ref. 11, p. 134.
(31) MOUNTAIN GLACIERS.- DOE/EV/60235-1, Sept. 1985, pp. 216-231.
(32) PRECIPITATION.- Ref. 11, pp. 149-162.
(33) LAKE LEVELS.- See index in Ref. 3.
(34) PLATE TECTONIC ACTIVITY.- Cambridge Ency. Earth Sciences,pp. 177-188; and Ref. 4-6.
(35) EARTHQUAKE ACTIVITY.- Data search incomplete.
(36) VOLCANIC ACTIVITY.- Simkin et al, Volcanoes of the World (1981).
(37) MINI-MICRO SIMULATION SUB-SYSTEMS.- Howard T. Odum, Systems Ecology (1983).
(38) BLOCK SIMULATIONS OF MAIN CLIMATE LOOPS.- For Energy Balance and Radiative Convective Models, see Ref. 10, pp. 84-89.
(39) DETAILED STRUCTURE SIMULATION OF COMPLETE SYSTEM.- For General Circulation Models, see Ref. 10, pp. 89-147.
(40) CROP LOSSES.- Ref. 13,p. 394; SAIA?BULLETIN, news clips on crop losses.
(41) LOSS OF HUMAN LIFE.- Analysis incomplete.
(42) HUMAN MIGRATION PROBLEMS.-Analysis incomplete.
(43) PROPERTY LOSSES.- Analysis incomplete
(44) STATE OF MINERALS IN SOIL.- Sample soil test results in Earth Regeneration Society file.
(45) MINERAL CONTENT OF FOOD.- Reference tables need updating.

THEORETICAL BASE

(46) CONSISTENT WITH GAIA HYPOTHESIS.- Lovelock, GAIA - A new look at life on Earth (1979).

CONCLUSIONS

Twelve theories of climate change (columns) are tabulated against forty-six rows of experiments and data. The most significant three of the competing theories have been checked against as many of the forty-six sets of experimental data as was possible. Two columns have no disagreements (D), namely the SOIL NUTRITION GLACIATION CYCLE THESIS (Hamaker Thesis) and the 2500-YEAR LITTLE ICE AGE THEORY. The first of these has 29 agreements (A's) and the second has 22 A's. The SIMPLE GREENHOUSE WARMING THEORY has 7 A's and 3 D's. The SOIL NUTRITION GLACIAL CYCLE THESIS includes the Carbon Dioxide GREENHOUSE WARMING THeORY as a subsystem of the refrigeration cycle.

Both the SOIL NUTRITION GLACIATION CYCLE THESIS and the SIMPLE GREENHOUSE WARMing THEORY have in common the following action implications:

We must reduce the release of CO/2 into the atmosphere by reducing the burning of fossil fuels, reforesting the earth, and stopping the deforestation of tropical rainforests.

In addition the SOIL NUTRITION GLACIATION CYCLE THESIS points to the need for replenishing the natural distribution of minerals and trace minerals in the soil and protection of the natural microorganisms in the soil needed for transferring the minerals from the soil to tree roots.

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"ETTORE MAJORANA" CENTRE FOR SCIENTIFIC CULTURE

INTERNATIONAL SEMINAR ON NUCLEAR WAR

4th Session: The Nuclear Winter and the new Defense Systems: Problems and Perspectives
Erice - 19-24 August 1984
Sicily, Italy
ANTONINO ZICHICHI - CHAIRMAN

COEVOLUTION: SOME PROPOSITIONS

by
N. N. MOISEEV
Director of Research
Computer Centre of USSR Academy of Sciences
Vavilova 40, Moscow, 117333

1. An event took place last year whose significance has not yet been fully recognized. Independently of each other, using different computers as well as different models, researchers in the USSR Academy of Science's Computer Centre in Moscow and at the Centre for Climate Studies in the United States carried out calculations that indicated that a nuclear war on almost any substantial scale would lead to the human race's complete destruction. Today these findings are widely known and there is probably no need to turn once more to the meaning of "nuclear darkness" and "nuclear winter". Only the final conclusion matters, namely that no matter where a nuclear conflict would begin on our planet and no matter who would initiate the first strike, whether or not a retaliatory strike would follow, the entire human race would share a common fate: no one can hope to survive a nuclear catastrophe.

In effect this finding constitutes the equivalent of the discovery of an anti-bomb by Soviet and United States scientists of potentially enormous power. If properly utilized it should be able to paralyze the numerous forces that are prepared to use nuclear weapons in resolving contradictions and disputes.

2. 1983 also saw the completion of a significant stage in research on processes taking place in the Biosphere in which the Biosphere was viewed as a single integrated whole. While many important findings were published earlier it was in 1983 that science established the possibility of evaluating alternative courses of development of civilization itself, and thus of providing to those who wield power in this world a fundamental perspective on the development of global processes that could not have been gained with traditional methods.

The usual element of inertia that operates in situations in which new ideas collide still makes it difficult to recognize its implications. Yet I am persuaded that already in the very near future the findings relating to nuclear war will exert a significant influence on the basic values of our civilization and hence on the global political process as well.

Two propositions follow.

First: further advances in the instruments of global analysis that were developed in the Soviet Union and in the United States are vitally needed.

Secondly: these instruments should be widely applied in arriving at quantitative characteristics of global processes and in evaluating the capacity of alternative development strategies to influence the course of human civilization.

3. Required advances in analytical instruments concern several distinct dimensions.

a. From the point of view of professional mathematicians current systems of models leave much to be desired; there is a need for substantial improvements in the way in which they are constructed and analyzed.

b. From the point of view of professional physicists a large number of mechanisms are insufficiently parametrised and many facts are inadequately reflected.

c. From the point of view of practitioners we still generally depend on information that is insufficiently reliable. Specialized services are needed to create and continually update data banks.

d. From the point of view of economists and political scientists our models do not reflect social structure adequately nor the economic and political spheres of human activity.

Points a. and b. are being studied intensively by Soviet researchers and I believe that this is also true in the United States.

Point d. requires that special international programmes be organized, presumably under the sponsorship of international organisations.

I will return to point c. later.

4. In spite of the need for intensive work on the further

improvement of models their current state does make it possible to arrive at answers to major questions that are posed by the further development of civilization. It is extremely important to formulate correctly the methodological basis for analysing systems of models representing the Biosphere. I believe that such a basis is provided by the principle of assuring man's further Coevolution with the Biosphere. That principle follows from the conceptualisation by V. I. Vernadski and Teilhard de Chardin of the Noosphere.

In the context of the pragmatic interpretation that it currently requires in the design of machine experiments it implies an emphasis on the identification of critical states of the Biosphere. I use this term to refer to those states that induce irreversible processes that violate the human race's viability boundaries or homeostasis.

Today we have identified one such critical value. This is the volume of soot in the atmosphere, which may also derive from sources other than nuclear war. There are probably many other "matches" that can ignite fires of planetary dimensions. The fire tornadoes that destroyed Dresden and Hamburg towards the end of the Second World War resulted from the use of conventional bombs by British and American Air Forces, yet their toll was as in Hiroshima and Nagasaki.

One should therefore take a far wider view of global model-assisted studies of the Biosphere. For that is the only method that is available for evaluating the possible consequences of human activities whenever real experiments are impossible.

Intensive discussions of a programme of machine experiments are currently taking place in the USSR Academy of Science's Computer Centre. I believe that a very important activity in machine simulation will be the analysis of various scenarios of disruptions of heat exchange processes between the atmosphere and the ocean. Changes in their characteristics may result from anthropogenic activities. Yet the ultimate consequences of such changes are comparable to those of a nuclear war.

5. Until now we have placed an emphasis on studying the Biosphere and we have made use of a variety of exogenous scenarios when describing human activities. Today, however, this is no longer sufficient. The scenarios themselves should result from analytical studies.

Past efforts in modeling the socio-economic sphere were largely concerned with the evolution of economic factors. The studies of the Club of Rome offer an example. Yet a purely economic analysis can offer little help in what is in fact most important, namely, the search for ways to resolve the contradictions that are tearing human societies today. The problem of identifying contradictions together with procedures for resolving them through compromises defines the most important branch of research activities today. Methods for finding not merely acceptable compromises but also mutually advantageous compromises may one day exert a decisive influence on the further development of human societies.

That such compromises do exist follows from the obvious fact that in assuring man's further coevolution with the Biosphere the inhabitants of all continents are equally interested in preserving the human race.

6. The theory of compromises is currently one of the rapidly developing branches of science. New approaches and methods have been identified in recent years that make it possible to find mutually advantageous variants of compromises in complex contradictory situations. Let us consider two examples.

a. A regional economic situation in which aside from interest in its own development each participant requires a certain guaranteed level of economic stability (for example, in its access to pure water). It has been shown that in such situations there exists a stable and effective compromise. Methods have also been developed for calculating the parameters of corresponding cooperative mechanisms that provide a basis for implementing the desired compromise.

b. Compromises in a nuclear arms race: there, too, there have been a number of important results that may be described as follows.

Participants in a nuclear arms race may possess a variety of interests, including a striving for superiority in terms of a variety of indicators. But even when their interests coincide with those of a military-industrial complex, if they also seek to reduce the risk of a nuclear was this will define a stable, that is, mutually advantageous compromise. Methods have been developed that make it possible to calculate its parameters, including levels of armaments.

7. Modern science is thus developing a foundation that makes it possible to find and then select rational approaches to the further development of our civilization. The current level of knowledge in this regard and further advances in the analytical instruments that have already been developed point to the possible emergence of the age of the Noosphere, when Reason will become a decisive factor in nature's and society's evolution. Science is able to prompt certain variants of actions and evaluate them with due account of the real contradictions and actual situations that exist in our world. But in order that these potential possibilities may be utilsed for the good of the human race a number of conditions must be met. One of them is an international cooperation of scientists. But that can be useful in helping take major political decisions only if relevant scientific findings will have been recognized.

That, in turn, requires that such findings be obtained with the help of jointly accepted models and initial information. An example of that principle's effectiveness was provided by international response to the publication of calculations relating to the climatic consequences of a possible nuclear war. Even though they were carried out independently in the Soviet Union and in the United States the climatic models themselves were well known in both countries. Accordingly, the findings did not produce prolonged discussions.

The next stage calls for the creation of international working groups whose participants work within the framework of mutually agreed programmes. Such groups are especially needed for discussions of possible compromises.

Finally, the time has arrived to create data banks that will be accessible to all participants of particular joint research ventures. They should be developed within the framework of some international Institute.

I would like to conclude by expressing the following conviction. In spite of the very great complexity of the ecological situation, of the depletion of the planet's resources, and of all the contradictions in the objectives and strivings of individuals, countries, and regional groupings, there do exist rational alternatives for a joint development of man and nature - of which he is himself a part. And modern science does possess the faculty of finding the ways that lead to that harmony without which the human race cannot have a future. I am fully convinced that as scientists join their efforts in studying the problem of Coevolution they will find the ways that lead to the achievement of those ideals of harmonious relations between man and nature that are common to all world religions and to the world's philosophical teachings.

SECTION 1.5: MAN, NATURE and the FUTURE of Civilization.

Title Page, Contents, and Introduction only.

Nikita Moisseyev

MAN, NATURE AND THE FUTURE OF CIVILIZATION

"NUCLEAR WINTER" AND THE PROBLEM OF A "PERMISSIBLE THRESHOLD"

Novosti Press Agency Publishing House
Moscow, 1987

CONTENTS

INTRODUCTION

I would like to discuss in this book a number of problems which face people everywhere today, regardless of where they live—in the North or South, in big cities or in sparsely populated areas. These problems concern everyone, and no one can escape them. Mankind will have to devote all its intellectual and spiritual resources to solving these problems, to seeking a way out of a possible crisis, for the future of our civilization depends on this.

Our planet is entering an entirely new phase of its history when only collective thinking, collective will and the joint and purposeful efforts of people will make it possible to avoid a catastrophe and open up new prospects of mankind's further development.

Though I shall talk about the difficulties and possible calamities which are in store for mankind, my purpose is not to draw horrible apocalyptical pictures. On the contrary, I would like to show what possibilities modern science offers to man. Today science not only can foresee the bottomless chasms that may await the human race along the path of its development, but can also indicate where a safe passage between Scylla and Charybdis can be found.

To avoid dangers the wayfarer should know about them beforehand and seek ways of overcoming them before he meets them. The time factor here is of paramount importance. The sooner we find a sensible course of action, the less sacrifice people will have to make to safeguard their future.

Any delay at the start of a search for a new way, either because of ignorance or any other reason, may have tragic consequences for mankind. So, while having full confidence in the power of reason, I would like to impress upon the reader the seriousness of the problems discussed in this book. There is no time for complacency. The future has to be won. We still have a long and difficult path ahead; we have to have a sense of common destiny and common goals, to work out new moral principles and a new ethical basis of life on our plane*

Nikita MOISSEYEV (b. 1917), a prominent Soviet scientist and specialist, in applied mathematics, is deputy director of the Computing Centre of the USSR Academy of Sciences. He is well known for his works on spacecraft dynamics, trajectory calculation, atmospheric processes and information science. Nikita Moisseyev is a member of the USSR Academy of Sciences and the All-Union Academy of Agricultural Sciences, winner of a USSR State Prize and a member of the International Academy of Astronautics.

A SUMMING-UP

My purpose in writing this book was to show the reader the possibilities of modern science. Today science is trying to solve the most urgent problems of our time, and it is capable of finding a correct path in extremely difficult situations. But faith in man and his reason, equipped with the latest scientific facilities, should not make us feel complacent and underestimate real, existing dangers.

The growing might of modern industrial civilization increases not only man's power over nature but also nature's power over man—his dependence on the state of the biosphere. And man may easily cross the fatal threshold which marks the beginning of an unknown and unpredictable evolution of the natural environment in which there may be no place left for him.

But the development of powerful technical capacities is accompanied by the development of science which opens up new vistas of progress, points out dangers and suggests ways of finding compromise solutions designed to avoid a catastrophe.

The first results obtained in this new line of research are already quite impressive, for they indicate new, alternative approaches to the present-day global situation and ways of civilization's further development.

Regrettably, these problems are being tackl today by small and separate groups of scientist whose work is almost unknown to the broad public, sometimes even to those on whom global decisions depend. It is necessary, therefore, to unite the ef forts of scientists working in different fields.

When I say "scientists" I do not mean only mathematicians, geophysicists, biologists and other "natural scientists". Our colleagues in the humanities can also play a big role. The fact is that natural scientists can indicate the limitations imposed b nature on human activity, but any restrictions c bans relating to human activity can only be p into practice by people. Here is where economist sociologists and other scholars should take ov and show how the spontaneous solution of contr dictions must give way to institutions of accor They should explain to people that the world tod is quite different from what it was at the beginning and even in the middle of the 20th century. This means in effect that mankind faces the onset of an epoch that needs new ethics and new morals.

But this is a separate subject.

SECTION 1.6 EDUCATION APPROACH (GREEN)

EDUCATIONAL DEVELOPMENT: Education of the public and their governmental representatives with respect to climate changes and the biosphere including major components such as the tectonic system, the oceans, the land, soil minerals, forest nutrition functions, photosynthesis, the atmosphere, the carbon cycle in the biosphere and general tectonic-biospheric- atmospheric interconnec -tions.

Sec. 1.6 Basic Understanding of Glaciation Cycles

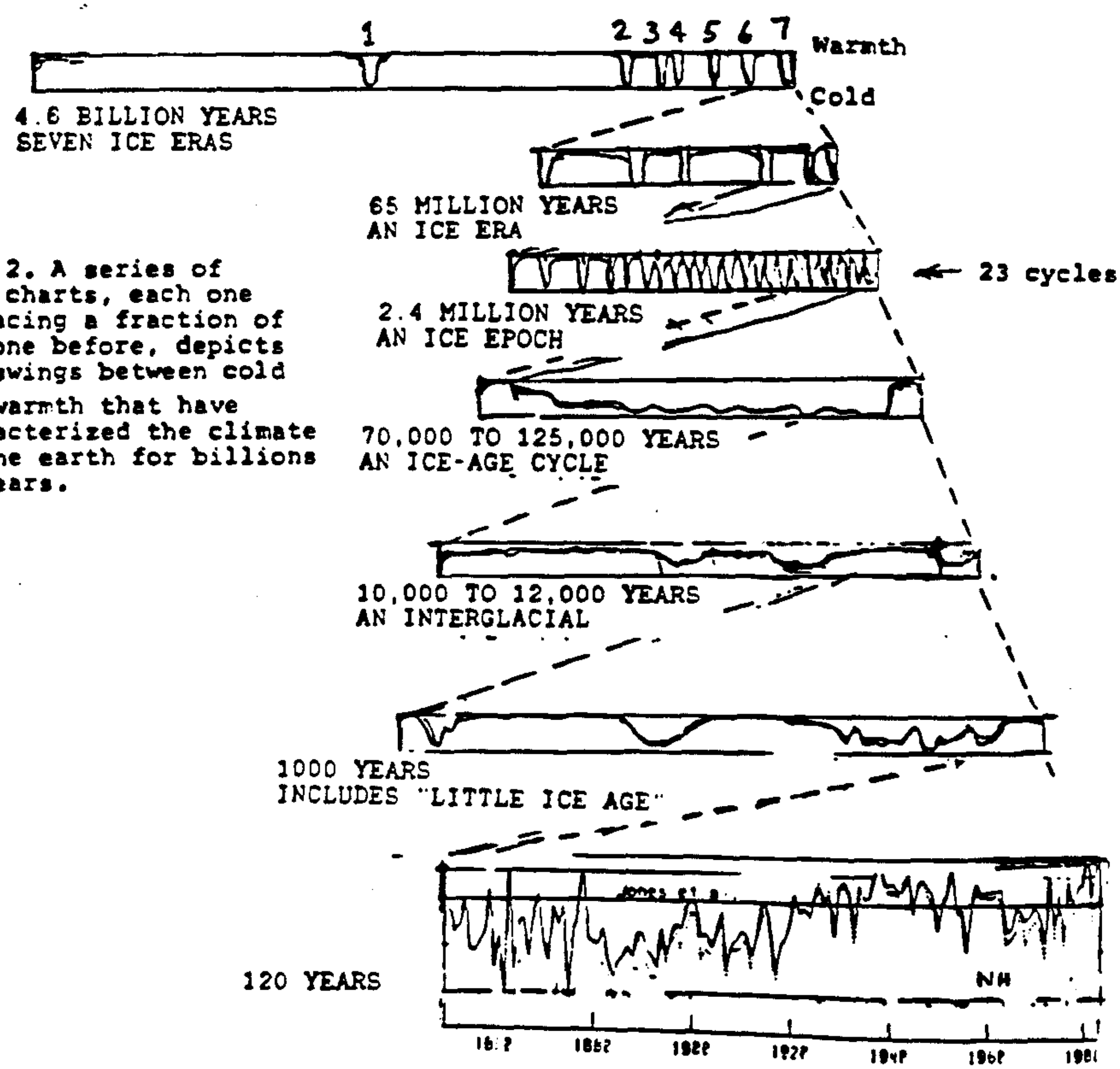


Fig. 2. A series of time charts, each one embracing a fraction of the one before, depicts the swings between cold and warmth that have characterized the climate of the earth for billions of years.

Geophysical and ecological data indicate that we are at least moving into another mini "Glacial Period."

C. Bertrand Schultz
Institute for Tertiary-Quaternary Studies (TER-QUA),
Nebraska Academy of Sciences, Inc.; and
Department of Geology and State Museum
University of Nebraska-Lincoln; and

Marian R. Schultz,
Institute for Tertiary-Quaternary Studies
Lincoln, Nebraska 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 diminution 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.

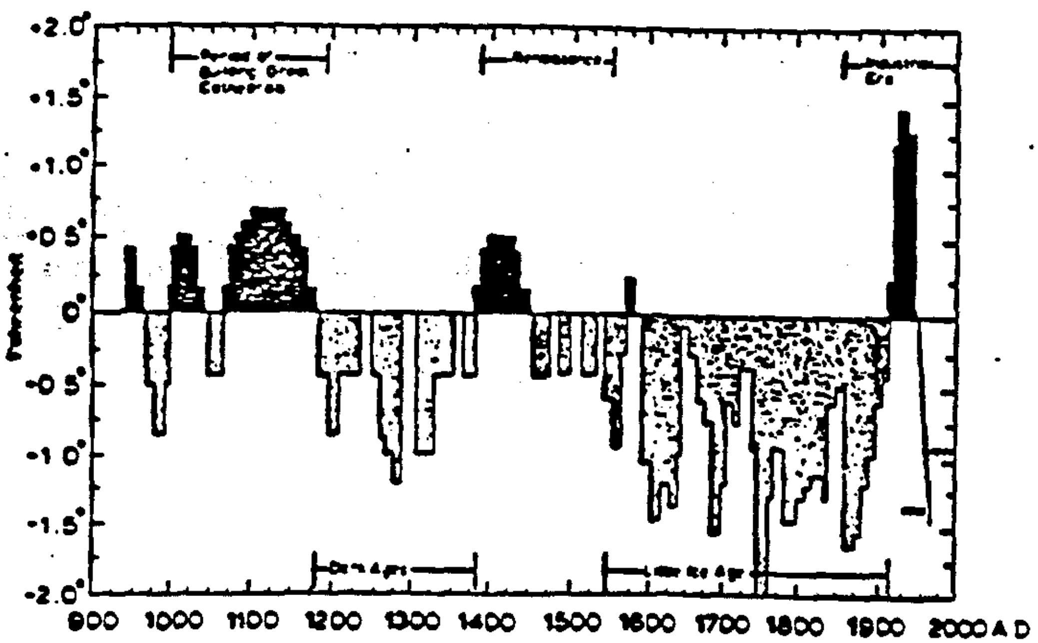


Figure 4. Chart showing temperature changes in Iceland during the past 1,000± years. The events shown in the chart indicate how complex the entire Quaternary history must have been, since this represents only the time of the formation of the lowest 6 m-high Terrace-0 valley-fill in the central Great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

Preliminary Release for
Circulation in November 1988

Spiral Involution and Reproductive Regeneration Models of the Biosphere in a Conceptual and Illustrative Mode for the Bolivian Case

by

Carlos Aliaga Uria
Regenerative Biospheric
Management and Engineering

P.O. Box 61053, Palo Alto, California 94306, USA

for

Computer Social Impact Research Institute
2346 Lansford Avenue
San Jose, California 95125

and

Earth Regeneration Society, Inc.
1442A Walnut Street, Box 57
Berkeley, California 94709
Contract Nos. ERS-2001 and ERS-2002

26 October 1988

To be published, December 1988, in:
Handbook for a Shareable Strategy
of Coevolution with the Biosphere
Fred Bernard Wood, PhD, Editor

Spiral Biospheric Involution Model (SBIM):
Conceptual and Illustrative Mode of the Bolivian Case

Current Status:
- Increment of atmospheric CO/2 from energy use
- Advance of deforestation
- Trace minerals worn out from soils

= (A)

Effect of (A): Variation of Global Climate (warming & cooling) = (B)

Effect of (B):
- Rain patterns (spatial & temporal) shifted (e.g. rains "not coming on time" in the Altiplano region); droughts and floods
- Frost occurring when unexpected
- Decrease of agricultural production

= (C)

Effect of (C):
- Increased poverty of the land → exodus from rural areas to:
  - a) Urban centers → threat to property → more funds go to "crime control" → less funds for sustainable economic infrastructure and ecodevelopment
  - b) Tropics and humid subtropics, such as rain forests, to, for instance, grow coca for cocaine production → more crack → population affected by drugs — e.g., Chicano and Blacks in the poor North American metropolitan centers → crime increment → higher threat to property → more arms for "crime control" → less funds for peaceful conflict resolution and education

= (D)

Effect of (D):
- Increment of violence, repression
- Limbic level (malnutrition induced irrational and violent) ways to deal with conflict resolution
- Increment of nutrition poor (junk) food consumption and production
- Overpopulation tendencies

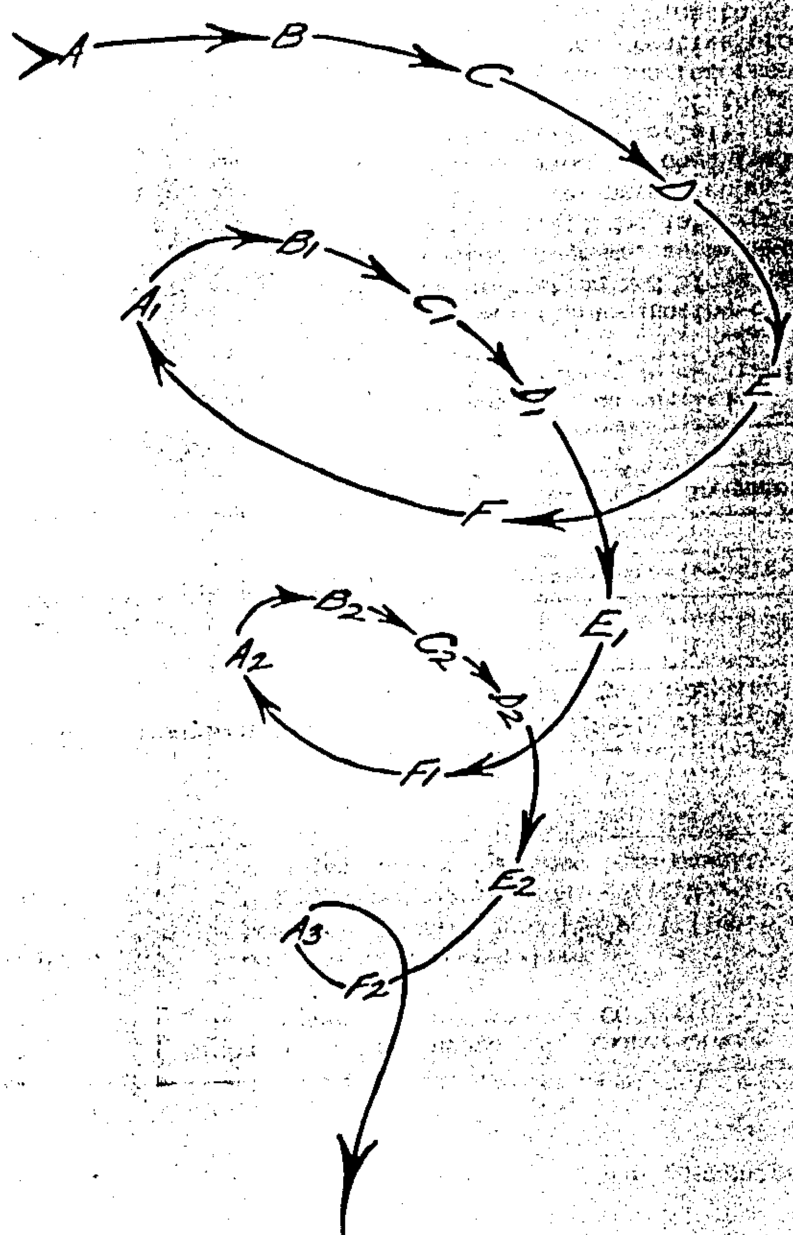
= (E)

Effect of (E):
- Higher demand for resources (e.g., higher energy requirements)
- Higher investment and expansion of warfare economic systems

= (F)

Effect of (F): (A) but at a higher level of Involution, degeneration = (A1)

Effect of (A1) = (B1); Effect of (B1) = (C1); and so on.


A
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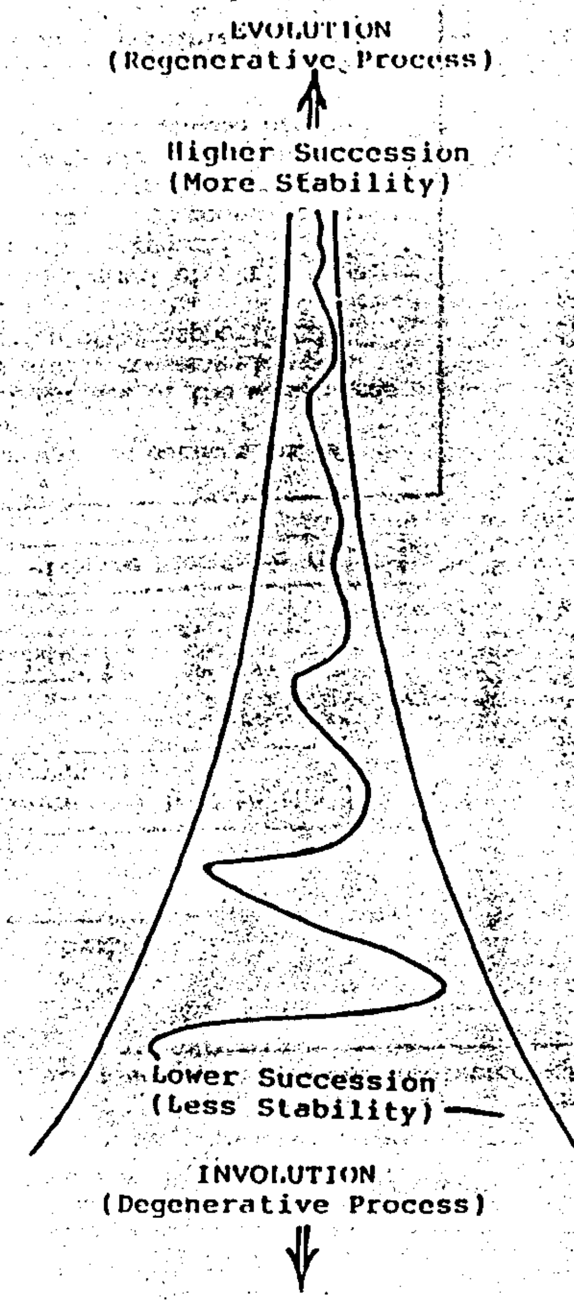

EVOLUTION
(Regenerative Process)
Higher Succession
(More Stability)
Lower Succession
(Less Stability)
INVOLUTION
(Degenerative Process)

SBIM

Spiral Biospheric Reproductive Regeneration Model (SBRRM)

Current status:

Global climatic instability induced by:
- Increment of atmospheric CO_2 from energy use
- Dying forests
- Advance of deforestation
- Loss of minerals from the soil (leached down, eroded, other)
- Higher demand for resources (e.g., due to poverty-of-the-land-induced over population and long term poverty inducing warfare economic systems)

⇒ Spiral Biospheric Involution (SBI)

Solution against SBI: Spiral Biospheric Reproductive Regeneration (SBRR) which will lead to the perpetuation of biological diversity and ecological complexity

Initial achievement of SBRR: Regenerative global climatic stabilization (RGCS)

Initial achievement of (RGCS): Through a Shareable Strategy of Coevolution with the Biosphere (SSCB)

SSCB includes:
- Enhanced human nutrition
- Soil nutrition (e.g., remineralization as needed, as well as optimum humus content)
- Appropriate monitoring of the conditions of the soil surface of the watersheds
- Reforestation and aforestation, combined with other biota, conservation and energy programs, such as to bring about a 20% reduction of atmospheric CO_2 before it is too late (possibly within 15 years)
- Alternative energy technology development (e.g., solar thermal electric power plants, wind, alcohol fuel, hydrogen fuel -- avoid further production of radio-active material); and accelerated decrease of fossil fuel consumption
- Ecotransformation of the world's military-industrial and scientific complex into institutions for research, development and implementation of humane mind evolution and creative production alternatives, for the perpetuation of the full array of the earth's biological diversity
- Addressing the foreign debt of less industrialized nations in the context of the urgent need to stabilize the global climate as soon as possible (consider Norway's policy as an example)
- Labelling of products whose manufacture does not harm the environment

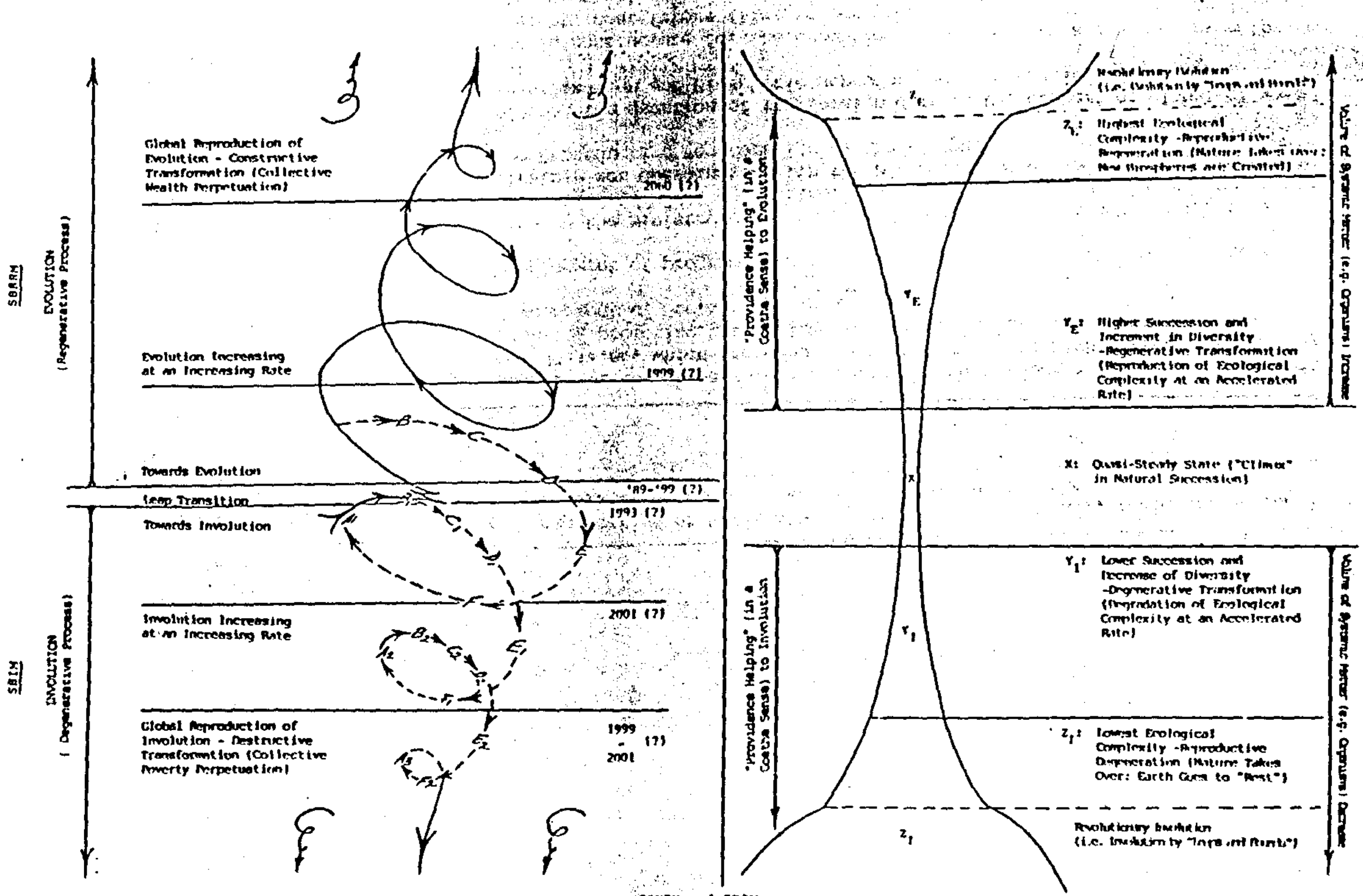
Conceptual and Illustrative Mode of the SBRR Model for the Bolivian Case

Current status: Basically that of (C) -- refer to SBIM

Solution for (C)/Bolivia: Application of SBRRM at the local (e.g., communal), regional, national, global levels -- at the present, near future and for the long term

Initial steps for the application of SBRRM/Bolivia include:

- Support of the Chapare regional development project as proposed in "Amendment No. 7" (i.e., which proposed the inclusion of the High Valleys Region), by means of promoting the implementation of the "Program for Alternative Development of Cochabamba" to its fullest
- Development of programs similar to the above for the rest of the Country
- Through the Ministry of Planning and Coordination, launch a comprehensive initiative to adopt and further develop the Bolivian version of the Shareable Strategy for Coevolution with the Biosphere, as an initial stage to achieve the Reproductive Regeneration of the Biosphere
- Address the question of the foreign debt in the context of global climate stabilization and Biospheric Reproductive Regeneration
- Set infrastructure for the promotion of ecoindustry and ecocommerce for the present, near future (five to ten years) and for the 20th century (e.g., environmental Nanotechnology)



SBRRM and SBIM
(Depict main trends on qualitative basis only)

SECTION 2 SCIENCE APPROACH (SALMON)

SCIENTIFIC RESEARCH: Accelerated implementation of basic interdisciplinary research in the approximately 25 fields of science involved in understanding the climate and biosphere, and including better communication be established between the different fields of science.

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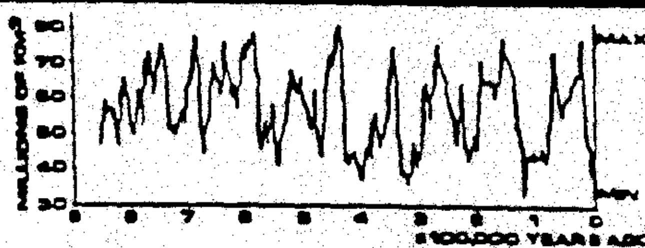
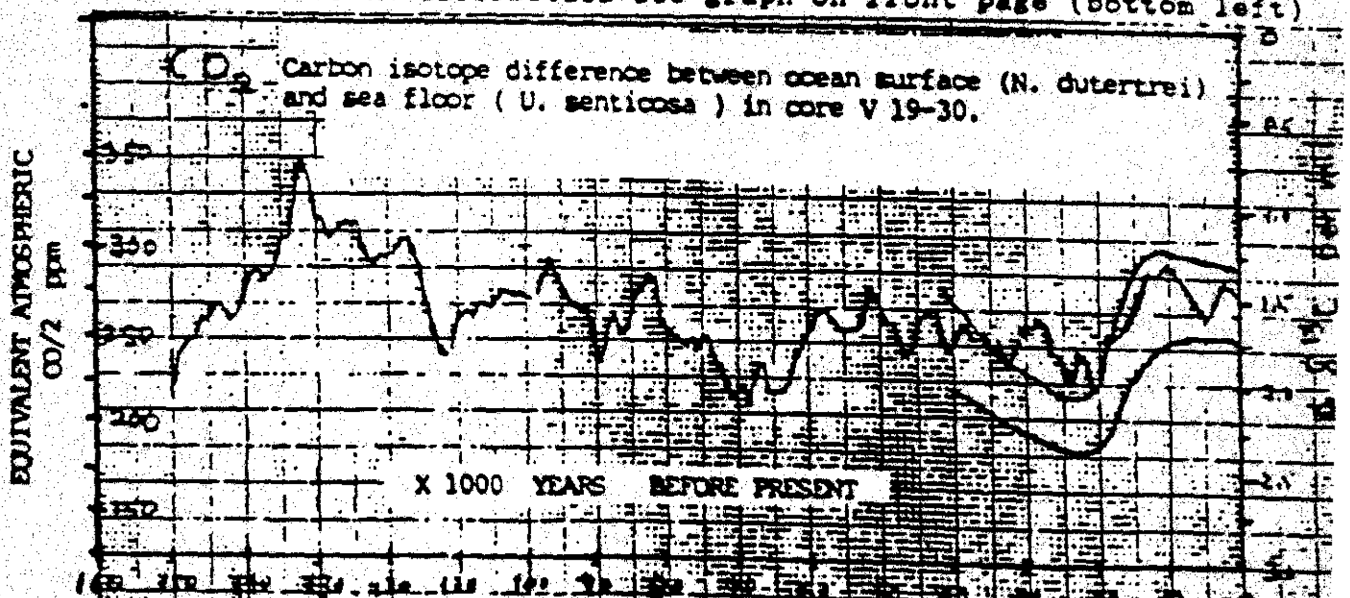
Section 2.0 Experimental Data on Glacial Ice Volume and Carbon Dioxide.

ATMOSPHERIC CARBON DIOXIDE INCREASE AND PROPOSED REDUCTION



VARIATION OF GLOBAL ICE VOLUME

0 point (present) on the graph below is an average count of the last 48 years. For current information see graph on front page (bottom left)



N. J. Shackelton, M.A. Hall, J. Line, & Cang Shuxi, "Carbon isotope data in core V 19-30 confirm reduced carbon dioxide concentration in ice age atmospheres." Nature , Nov. 24, 1983, vol. 306, pp. 319-322 (ERS #96)

Section 2.1: Global Climate/Earth Monitoring and Modeling: An Interdisciplinary Evaluation.

Fred B. Wood*
Office of Technology Assessment
U.S. Congress
Washington, D.C. 20510

ABSTRACT 5/26/86

Climate is a particularly important component of the earth system because of the short- to medium-term impacts of climatic change in such 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.

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Office of Energy Research
Office of Basic Energy Sciences
Carbon Dioxide Research Division
Washington, D.C. 20545

DETECTING THE CLIMATIC EFFECTS OF INCREASING CARBON DIOXIDE

Edited by:

Michael C. MacCracken and
Frederick M. Luther

Lawrence Livermore National Laboratory
Livermore, CA 94550

FOREWORD

Over the ages, human communities have had little or no effect on the Earth's global climate. Humans have accounted for only a small part of all of the species on the planet, and their activities have been essentially benign relative to the global atmosphere. Historically, communities were small and distant from each other and transportation was slow and difficult. Very little energy was consumed, with the burden of work being carried by humans and their domesticated animals with the assistance of elementary machinery.

Science and technology paved the way for the rapid societal changes of the 20th century. With the development of transportation and communication systems plus the machinery for industrial and agricultural production, global energy consumption grew by more than 10-fold from 770 million metric tons (10^{12} grams) of coal equivalent (mmtce) in 1900 to more than 9000 mmtce in 1984. Most of this energy was produced by burning fossil fuels. The world's population increased by threefold during the same period from 1.6 billion to 4.8 billion. (The American billion, 10^9, is the same as the British milliard, 10^9.) Urbanization, which resulted in a major increase in demand for energy, recorded an almost 20-fold increase in 84 years, as measured by the number of urban areas with populations greater than 1 million, expanding from 13 to 247 worldwide.

This immense increase in energy use is changing the layer of gases that constitutes the Earth's atmosphere, which in turn controls global climate. So, for the first time in the planet's history, humans are truly involved in a change of their environment.

Carbon dioxide (CO_2), a naturally occurring constituent of the atmosphere, is also the product of human activities—the burning of fossil fuels for energy and the clearing of land for agriculture and urbanization. Toward the end of the 19th century, Arrhenius calculated that a doubling of the CO_2 concentration would raise the average temperature by 5 or 6°C. Chamberlain later developed a hypothesis that related causes of glacial periods and the depletion of the atmospheric CO_2 concentration. Tolman, a student of Chamberlain, described the basic roles of the ocean in absorbing atmospheric CO_2 and moving and storing it globally.

Another important role of CO_2 was also recognized more than a century ago. Von Liebig demonstrated that plants get their carbon for photosynthesis and growth from the air. By this process, a relative atmospheric constancy is maintained where assimilation by plants is roughly balanced by CO_2 exhalation by animals. This notion of constancy became dogma until modern measurements clearly showed a change in the atmospheric concentration of CO_2 due to human intervention.

It is now known that the atmospheric CO_2 concentration in 1900 was approximately 300 parts per million by volume (ppm) (indicated by recent measurements of glacial ice cores by Oeschger). However, it wasn't until 1938 that Callendar presented the first substantive data showing that the concentration of CO_2 in the atmosphere was increasing and suggested that the increase might affect the Earth's climate. After another 20 years Keeling began to monitor the atmospheric CO_2 concentration at the Mauna Loa Observatory in Hawaii. The measurements of atmospheric CO_2 in 1958 showed the annual average concentration was 316 ppm; it was approximately 345 ppm in 1985. Plass outlined theories to explain the relationship between atmospheric CO_2 and climate in 1956, and, soon after, Revelle and Suess described the relationship between CO_2 in the atmosphere and in the oceans, and Kaplan enlarged upon the role of CO_2 in the atmosphere in terms of the global heat balance.

In 1977 leading scientists assembled in Miami Beach, Florida, to discuss the current understanding of the carbon cycle, that is, the dynamics of carbon exchanges within the Earth's atmosphere, land, and oceans that determine the atmospheric CO_2 concentration. They also reviewed possible consequences of increases in atmospheric CO_2. In addition, they identified significant gaps in the knowledge base and made recommendations for research.

Since then, significant research has been carried out by the international scientific community. The Department of Energy (DOE), the lead United States agency in the study of CO_2, and other agencies including the National Science Foundation, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, United States Geological Survey, United State Department of Agriculture, and Environmental Protection Agency, following the recommendations of the science community, have conducted and supported research activities in universities, national laboratories, industry, and other institutions.

Looking forward to the 21st century, the DOE believed it was important to "take an accounting" to see how far this considerable effort had come in 8 years in answering the questions that were previously posed and in determining future research directions. Accordingly, the Carbon Dioxide Research Division, Office of Basic Energy Sciences, of the DOE is publishing this series of four State-of-the-Art (SOA) volumes:

- *Detecting the Climatic Effects of Increasing Carbon Dioxide*—to detect the changes in climate resulting from the increasing atmospheric CO_2 concentration and to isolate the climate changes from those caused by other contributing factors (natural or anthropogenic).
- *Projecting the Climatic Effects of Increasing Carbon Dioxide*—to project the magnitude and rate of the potential climate changes that could result from the increasing atmospheric CO_2 concentration.
- *Atmospheric Carbon Dioxide and the Global Carbon Cycle*—to understand the mechanics of and quantify the sources, sinks, and exchanges of carbon between all elements of the global carbon system—the atmosphere, the biosphere, the oceans—including anthropogenic effects.
- *Direct Effects of Increasing Carbon Dioxide on Vegetation*—to determine the plant response to increased atmospheric CO_2 and develop the capability to predict crop and ecosystem responses to CO_2 enrichment.

An index and cross-reference volume accompanies the set of volumes. Two companion reports are also being published:

- *Characterization of Information Requirements for Studies of CO_2 Effects: Water Resources, Agriculture, Fisheries, Forests, and Human Health.*

- *Glaciers, Ice Sheets, and Sea Level: Effects of a CO_2-Induced Climatic Change,* from the National Research Council's (NRC) Committee on Glaciology of the Polar Research Board.

These complementary reports aid in ensuring that "the accounting" of CO_2 research activities for the past years encompasses the entire spectrum of research.

The SOAs document what is known, unknown, and uncertain about CO_2 data, analyses, and modeling capabilities. They outline potential avenues of research for reducing critical unknowns and uncertainties. More than 70 scientists from five nations have participated in the preparation of these volumes. Each chapter and each complete SOA volume has gone through extensive peer review by the American Association for the Advancement of Science (AAAS); this review, however, does not imply that AAAS endorses the statements or recommendations presented in these volumes.

These technical reports provide the basis for a Statement-of-Findings (SOF) report. While studies over the last several years have clearly shown that increasing CO_2 concentrations have the potential for significant impacts on our physical environment, these studies have not yet provided an adequate basis for addressing questions about the fundamental relationships between the benefits and impacts of various energy systems on society's activities. The SOF will summarize what we know and do not know and the degree of certainty of our knowledge. It will also present the rationale for further studies. These studies will be needed to provide an accurate scientific basis for assessments of the potential impacts of energy-related activities.

The citizens of today's nations have the responsibility for the stewardship of all the Earth, including their actions which may affect its climate. Exercising this responsibility requires an understanding of atmospheric CO_2 and its effects. Once understood, stewardship then becomes nurturing rather than unrecognized neglect.

Scientists have created the building blocks for this understanding, and the scientific community has recognized its responsibility to more fully understand CO_2-induced effects on our global environment. Through research, as we look towards the 21st century, the application of science will ensure that the additional understanding required for nurturing our planet Earth will be developed.

Sincere thanks go to everyone who has participated in developing the SOAs and companion reports. Special thanks go to the coordinator/editors, Jennifer D. Cure, Frederick M. Luther, Michael C. MacCracken, Boyd R. Strain, John R. Trabalka, Margaret R. White, and the NRC Committee Chairman Mark Meier; their respective chapter authors; and to the AAAS, Roger Revelle, Chairman of the Climate Committee, and David M. Burns of the AAAS staff.

We hope these definitive, scientific statements will motivate scientists to recommend explicit approaches for reducing the critical uncertainties that now exist in order to permit decision making within the next decade that is based on data, learning, understanding, and wisdom.

Frederick A. Koomanoff, Director
Carbon Dioxide Research Division
Office of Basic Energy Sciences
U.S. Department of Energy

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United States Department of Energy

Office of Energy Research
Office of Basic Energy Sciences
Carbon Dioxide Research Division
Washington, D.C. 20545

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CHARACTERIZATION OF INFORMATION REQUIREMENTS FOR STUDIES OF CO_2 EFFECTS: WATER RESOURCES, AGRICULTURE, FISHERIES, FORESTS AND HUMAN HEALTH

Edited by:

Margaret R. White
Biology and Medicine Division

Lawrence Berkeley Laboratory
Berkeley, CA 94720

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United States Department of Energy

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Office of Basic Energy Sciences
Carbon Dioxide Research Division
Washington, D.C. 20545

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PROJECTING THE CLIMATIC EFFECTS OF INCREASING CARBON DIOXIDE

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Edited by:

Michael C. MacCr[illegible] [illegible]d
Frederick M. Luthe

Lawrence Livermore [illegible]onal Laboratory
Livermore, CA 9455[illegible]

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Office of Basic Energy Sciences
Carbon Dioxide Research Division
Washington, D.C. 20545

DIRECT EFFECTS OF INCREASING CARBON DIOXIDE ON VEGETATION

Edited by:

Boyd R. Strain and
Jennifer D. Cure

Duke University
Durham, NC 27706

CONTENTS

United States Department of Energy

Office of Energy Research
Office of Basic Energy Sciences
Carbon Dioxide Research Division
Washington, D.C. 20545

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ATMOSPHERIC CARBON DIOXIDE AND THE GLOBAL CARBON CYCLE

Edited by:

John R. Trabalka

Oak Ridge National Laboratory
Oak Ridge, TN 37831

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Carbon Dioxide Research Division
Washington, DC 20545

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Master Index for the Carbon Dioxide Research State-of-the-Art Report Series

Edited by:

Michael P. Farrell

Oak Ridge National Laboratory
Oak Ridge, TN 37831

FOREWORD

Publishing the SOA series has been a rewarding experience for all of us. The hundreds of reviews received before publication, the positive comments receiv after the reports were published, and working with the coordinator/editoi authors, and support staff has reaffirmed for all of us the team spirit needed to scrutinize and analyze the body of science on CO_2 and the greenhouse effect.

We have made these reports available to many individual scientists and policy makers who are concerned about the consequences of increased atmospheric CO_2 concentrations. Over 3,000 copies of the reports have been sent to researchers in 150 countries. To ensure that these reports are available for some time in the future, hundreds of libraries, training centers, and information centers were sent the complete series of reports. Of the libraries, 219 in the USA and 126 foreign libraries in 49 countries received copies. The SOA reports are now available in about 90% of the world's countries.

Publishing the SOA series has also been a learning process for all of us. We are indebted to the many authors and reviewers for giving us their expert knowledge on the many complex problems related to the CO_2 issue.

We at the U.S. Department of Energy would particularly like to thank the coordinator/editors for helping us through the process of reducing the vast body of scientific information on CO_2-climate interactions. Again our thanks to Jennifer D. Cure, Frederick M. Luther, Michael C. MacCracken, Mark Meier, Boyd R. Strain, John R. Trabalka, and Margaret R. White.

Without the help of these many scientists, we would not be in a position tc prepare our research plans for the next decade.

Finally, we want to acknowledge the invaluable assistance of Dr. Fred anc Linda O'Hara who prepared the index to each volume in the SOA series.

Frederick R. Koomanoff, Director
Carbon Dioxide Research Division
Office of Basic Energy Sciences
U.S. Department of Energy

PREFACE

If the concentration of carbon dioxide (CO_2) in the atmosphere continues to increase, the Earth's climate could be modified with attendant effects on human health and natural resources such as agriculture, forests, fisheries, and water. To assess the effects of this increase, scientists must deal with two difficulties: the enormity of the problem and the diversity of the disciplines contributing to its solution. This enormity and diversity make it difficult to (1) define the problem, (2) develop strategies for solving the problem, and (3) establish communication and cooperation among the researchers working on different facets of the problem. Therefore, the compilation, integration, interpretation, and dissemination of information are especially important.

It was to aid this compilation, integration, interpretation, and dissemination that the four State of the Art (SOA) reports, *Atmospheric Carbon Dioxide and the Global Carbon Cycle*, *Direct Effects of Increasing Carbon Dioxide on Vegetation*, *Detecting the Climatic Effects of Increasing Carbon Dioxide*, and *Projecting the Climatic Effects of Increasing Carbon Dioxide*, and the two companion reports, *Characterization of Information Requirements for Studies of CO_2 Effects: Water Resources, Agriculture, Fisheries, Forests and Human Health* and *Glaciers, Ice Sheets, and Sea Level: Effect of a CO_2-Induced Climatic Change*, were published by the U.S. Department of Energy's Carbon Dioxide Research Division. These reports were produced in February 1986, March 1986, February 1986, April 1986, July 1986, and October 1985, respectively. However, to make reference easy and to allow more effective bibliographic control, they were given the same date of publication, December 1985, except for *Glaciers*, a version of which was previously published by the National Research Council and which still bears that agency's date of publication.

Considerable information on atmospheric carbon dioxide and its possible effects on world climate is summarized in these six volumes. Each volume has its own index, but to make the information that is distributed throughout the six volumes more accessible and usable, comprehensive citation and subject indexes have been compiled. The subject indexes of the individual volumes have been edited to provide a uniformity from volume to volume and also to draw distinctions not needed in the separate volumes' indexes. For example, the term "Accumulation" clearly refers to biomass carbon in the Global Carbon Cycle and Direct Effects SOA volumes and to glacial snow and ice in the Glaciers/Sea Level volume. But in the comprehensive subject index, the distinction between "Accumulation of carbon" and "Accumulation (glacial)" must be made. Also, the comprehensive subject index has been formatted in a matrix arrangement to graphically show the distribution of subject treatment from volume to volume. Other aids have also been provided to allow the reader to make comprehensive and convenient use of the six volumes. These aids include cross references between the scientific and common names of the animals and plants referred to, a glossary of special terms used, tables of data and conversion factors related to the data, and explanations of the acronyms and initialisms used in the texts of the six volumes.

Finally (but actually presented first), the executive summaries of the six volumes are collected and reproduced here to allow the readers interested in the contents of one volume to rapidly gain information on the contents of the other volumes.

I would like to thank Dr. Frederick O'Hara and Linda O'Hara for their work in compiling and checking the citation and subject indexes, Laura O'Hara for her work in producing the scientific and common name indexes, Michael O'Hara for performing the makeup of this comprehensive index volume, and Dr. Bruce Ewbank for the computer preparation of the subject-index information for phototypesetter output. I would also like to thank Dr. Raymond Millemann, Donna Stokes, Tammy White, Cheryl Buford, and the rest of the staff of the Carbon Dioxide Information Analysis Center for their assistance throughout the SOA process.

Michael P. Farrell, Editor

CONTENTS

SECTION 2.3: MAN and the BIOSPHERE - Experiments based on system analysis with models (computer).

N.N. Moiseev, V.V. Alexandrov, and A.M. Tarko.

Title Page, Sample Plot, Contents, and Introduction only.

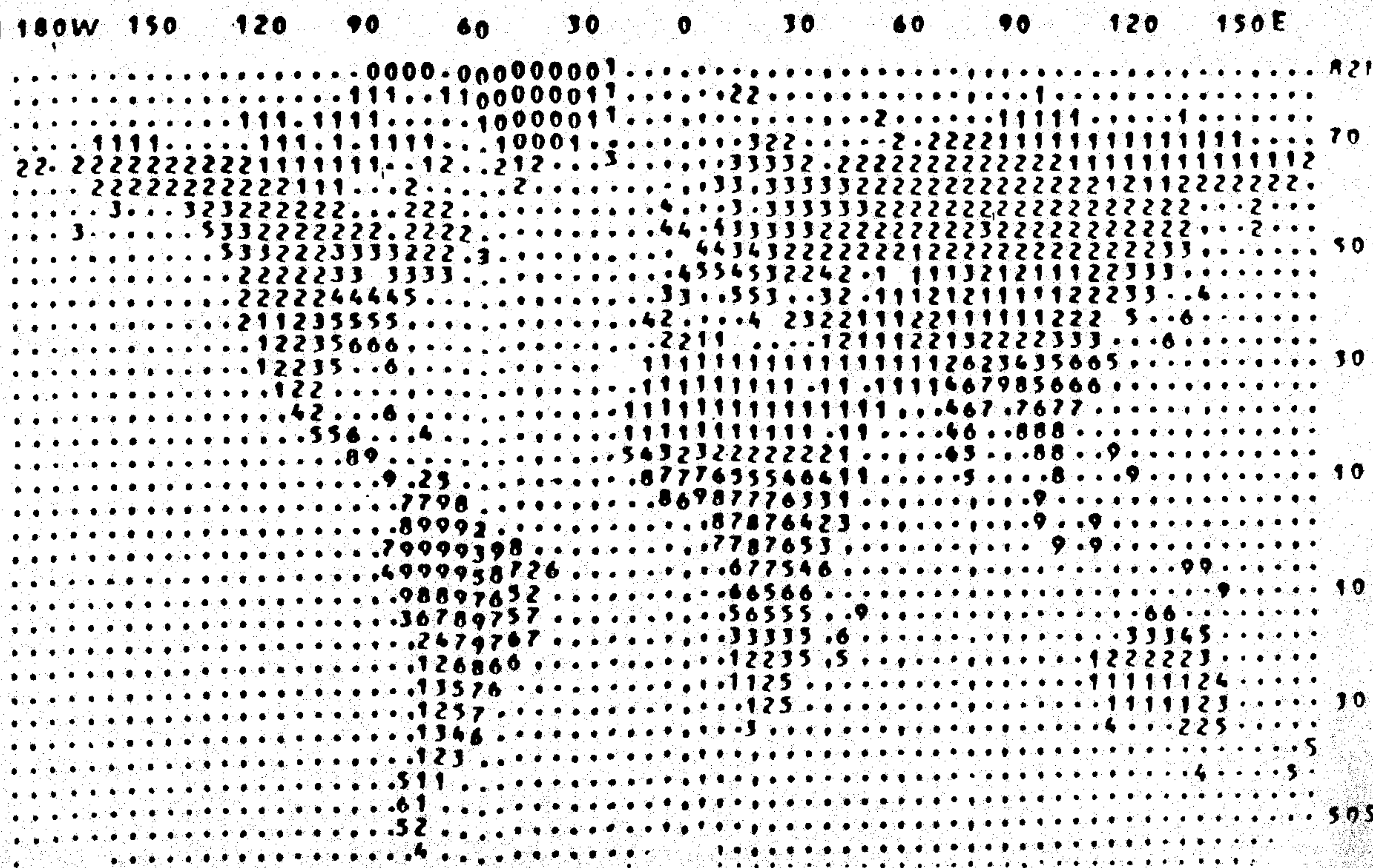
Н.Н.МОИСЕЕВ
В.В.АЛЕКСАНДРОВ А.М.ТАРКО

ЧЕЛОВЕК И БИОСФЕРА

ОПЫТ СИСТЕМНОГО АНАЛИЗА И ЭКСПЕРИМЕНТЫ С МОДЕЛЯМИ

МОСКВА "НАУКА"
ГЛАВНАЯ РЕДАКЦИЯ
ФИЗИКО-МАТЕМАТИЧЕСКОЙ ЛИТЕРАТУРЫ
1985

РАСЧЕТ НА ЭВМ ГОДИЧНОЙ ПРОДУКЦИИ РАСТЕНИЙ СУШИ



ОГЛАВЛЕНИЕ

ПРЕДИСЛОВИЕ

В основе этой книги лежат доклады, которые были подготовлены авторами для семинара Международного института жизни, проходившего в сентябре 1983 г. в Хельсинки. В книге приводятся некоторые результаты многолетней работы, которая ведется в Вычислительном центре Академии наук СССР и имеет своей целью развитие математических методов исследования процессов, протекающих в биосфере. Мы стремимся рассматривать биосферу как единое целое и изучать ее эволюцию в современных условиях, тогда основным фактором изменения характеристик биосферы становится человеческая деятельность.

Эти работы мы начали в середине семидесятых годов в двух направлениях. Была начата разработка моделей, описывающих процессы изучения климата (руководитель В.В. Александров), и глобальных моделей биоты (руководитель Ю.М Свирежев). Для замыкания этих моделей необходим еще блок, описывающий человеческую деятельность. Но именно это направление оказалось наиболее трудным. Опыт работ Римского клуба показал со всей очевидностью ущербность чисто экономических моделей балансового типа и попытки включить в них некоторые экологические факторы (моделирования демографических процессов и т.д.). Поэтому вместо моделирования человеческой активности в экспериментах с моделью биосферы мы ограничились рассмотрением отдельных сценариев. Лишь в самое последнее время нам, кажется, удалось "нащупать" рациональные подходы к анализу тех тенденций, которые определяют сценарии человеческой деятельности.

В результате десяти лет работы в ВЦ АН СССР была создана первая версия глобальной модели биосферы. Поскольку в ней описываются только процессы геофизической и биологической природы, ее естественно было назвать системой Гея. В начале восьмидесятых годов мы начали использовать эту систему для анализа конкретных сценариев. Особое значение имеет анализ сценария ядерной войны, предложенного К. Саганом, проведенный летом 1983 г. Система Гея к тому времени была единственной системой, которая позволила провести анализ климатических последствий ядерной войны и увидеть, как в течение года после ядерной катастрофы меняются климатические параметры, возникает и постепенно прогр... [illegible] ядерная ночь.

Мы старались информировать научную общественность о ходе наших работ. В журналах "Вестник АН СССР" и "Природа" в период 1979 – 1982 гг. было опубликовано около десяти статей

5

Кроме того, В.Ф. Крапивиным, Ю.М. Свирежевым и А.М. Тарко была опубликована монография "Математическое моделирование глобальных биосферных процессов" с изложением состояния вопроса о моделировании процессов, протекающих в биоте. В 1982 г. в издательстве "Наука" Н.Н. Моисеевым была опубликована небольшая монография "Человек, среда, общество", в которой обсуждались методологические проблемы математического моделирования процессов взаимодействия человека и окружающей среды.

Несмотря на эти публикации, предлагаемая коллективная работа является первым более или менее подробно документированным изложением системы Гея. Кроме того, в ней описаны основные крупномасштабные эксперименты с моделью и впервые изложена та концепция анализа процессов общественной природы, которая начала разрабатываться в последнее время в ВЦ АН СССР.

Книга состоит из семи глав. Главы 2 – 4, посвященные изложению климатической модели и соответствующим экспериментам, написаны В.В. Александровым, главы 5, 6, посвященные биологическим моделям, написаны А.М. Тарко. Глава 1, содержащая методологическое введение, и глава 7, посвященная простейшим моделям компромиссов, написаны Н.Н. Моисеевым.

Завершение работы над моделью и книгой в значительной степени обязано внимательному отношению к нашим исследованиям со стороны Е.П. Велихова и А.А. Дородницына, которым авторы выражают искреннюю благодарность.

SECTION 2.4:

THE MISSING LINKS BETWEEN PLANT ROOTS AND COLLOIDAL SOIL PARTICLES

Dr. Gernot Graefe
Director of Institute for Bioenergetic Research
Austrian Academy of Science
(Forschungsstelle für Bioenergie der Österreichischen Akademie der Wissenschaften)
Bergstraße 10, A-7082 Donnerskirchen/ Austria
Tel. 02683/8543

Development of vegetation / CO_2 fixation/ Climate change/ Waldsterben / Re-structuring of linking systems in soils

Organisms, even highly organized ones as Homo sapiens, do not consciously perceive environmental influences, with few exceptions only. On the other hand, from the lowest to the highest species, all organisms react to influences on an existential level as to their beneficial or harmful effects: their answer is either heightened vitality or weakening and decay. While these interactions are at work continuously, natural science continuously faces the problem how to grasp and evaluate cross-connections.

When ecosystems get out of balance we should take this as an indication that links are missing: e.g. earthworms which mix organic substances with minerals and produce the clay-humus-complex; or mykorrhiza fungi which build bridges between plant roots and colloidal soil particles are no longer part of the system. Where on steep slopes soil is evidently starting to slide, the danger is caused by absence of networking and holding-to-each-other microorganisms which guarantee stability for the soil by closely interacting with the mykorrhiza.

Due to the high rate of anthropogenic influences, the number of links which undergo disturbances or destruction is ever rising and in all probability will rise even more the less we sharpen our knowledge of the system as a whole: Up to now natural science has not given the necessary credit to the importance of soil-networks for the ecosystem. These networks should now be acknowledged as an existentially important part of General Systems Research, including the feedback of quality to the development of world-climate, soil erosion and yields as well as longevity of forest-soils and farmlands.

*Rerinted from: <u>Problems of Constancy and Change - the complementarity of systems approaches to complexity</u> Volume I, pp. 441-447, 31st Annual Meeting of the International SOCIETY FOR GENERAL SYSTEMS RESEARCH, Budapest, Hungary, 1-5 June, 1987.

Reproduction of living species follows the laws of exponential growth. By doubling every species could, theoretically, reach a point where its gigantic populations would be forced to incorporate the bulk of biomass available. -This never happens because deficiendes hit at a much earlier stage. Apart from this, massive reproduction of species is prevented by competition for limited resources by the diversity of species and by their opposing interests.

Man emerges from this existential background and has become conscious of many deficiencies which cause considerable pain. Yet human consciousness still seems badly equipped to form an idea what really is existential for life on this earth. Man seems not very capable of forseeing the course and the effects of his own exponential growth. His ability to make use of nature's effective ways of building up ecosystems seem just as feeble.

If there are reasons to believe that, normally, competition prevents massive reproduction of one single species, we may assume that selfcontrol as far as reproduction is concerned was not a main issue for selection and that, consequently, man was not forced to build up perceptual ideas about how nature works. The history of Homo sapiens followed up the evolutionary pattern: selfcontrol is not desirable in the field of reproduction since it could become an obstacle whenever ecological niches turn up which invite colonization. - So Homo sapiens left his ecosystemal environment some 10.000 years ago without proper security measures against his rapidly developing ability to clean his path from obstacles, kill pest and nutrition competitors and become a paragon for exponential growth. The only built-in measure is his rising consciousness.

In order to direct man's "dualistic vitality" not into doubling steps of reproduction but into achieving new forms of integration with the ecosystemal environment pressure of selection confronts him with population densities and the degenerating effects of the industrial system for the ecosystem. - At this point General Systems Research could show that this integration, i.e. alleviation of problems, will lead us back to the soil. In future there will be not one field of research, be it the Sciences of the Arts which could afford to exclude the soil from its referential system. It would, otherwise, degenerate into nothing more than an auxiliary science.

Soil as a regional component carries the potential for regulation and improvement. Therefore it is so important.

Global phenomena, e.g. world climate, represent dangers, but their specific interactions with each region show a spectrum of regional phenomena, from destruction to beneficial effects. - Basically the thin layer of soil represents a level for exchange and buffering which is much more important for the ecological balance than is acknowledged yet. Therefore a realistic assessment for soil potential and soil value for the ecosystem as well as for global phenomena, e.g. world climate, will be necessary. Soil was the lifegiving element for the blooming human population, but the ignorance of man as to its efficiency to preserve existence on the globe has caused a vacuum which should now be filled quickly by Systems Sciences.

Life developed in the ocean more than three billion years ago. Water was not scarce, nutrients were available in solution just as in hydroponics. Terrestrial biotopes had to be conquered step by step some hundred million years ago. The carbon forests were situated in swamps. In places where humidity remained constant, vegetation pushed on into terrestrial regions, but nowhere it covered large expanses. Terrestrial land then mainly consisted of rock and stone rubble which was not able to hold humidity for longer periods: organic material as well as links for builing up longevity-soils were not yet to be found.

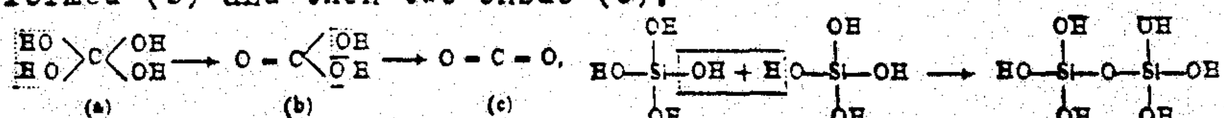
The mineral masses of the terrestrial biotopes represented a challenge for the exponential growth of micro-organisms, plants and animals. The step-by-step colonization was successful and reached its height twenty million years ago when grass was covering large continental expanses. - Colonization of terrestrial biotopes and the build-up of soils was the existential challenge of the past three hundred million years. For our century the most important challenge is the acknowledgement that soil is the basis for our present and future existenceand a factor for climate phenomena dangerously speeding up.

x x x

My personal knowledge as to the problematique of soil has benefited greatly from the works of highranking scientists in the UdSSR, the German Republic, Hungary and the USA. These scientists as well as many others have supplied the groundwork for further research and action which has to be done before the turn of the millenium! a cooperative comprehension instead of knoledge-accumulation by elites. The latter, part of our ecological fiasco, could be afforded only on the basis of ecosystems in full swing. Our time is one of rapidly degenerating ecosystems. As far as the eminently important soil problematique is concerned, not only experts, whose achievements and limits are evident, are needed: Further approach into questions of soil will preferably been done by those who are not only able to understand the subtle system of linkage between organic and mineral material in the soil, but also to supply a frame for the re-structuring and re-building on all levels.

The colloidal system of the soil could be called a universal meeting point, a place for reality and integration. For instance organic and anorganic chemistry, split up on academic grounds, perfectly meet as a structure-building, fuctional unity in the clay-humus-complex. While in anorganic chemistry some tenthousand compounds are known today, organic chemistry has described some hundred thousand. Based on its ability to undergo double-binds, carbon is free to organize in large varieties of configurations. Although it belongs to those elements which are relatively less abundant, it preferably accumulates wherever it is needed most in the biosphere. Looking, on the other hand, for the most abundant elements in the stone-cover of our planet, silicium comes into view. It is second in abundancy, but it is never to be found in its pure form. It always combines with oxygen, the most abundant element.

C and Si both are quatrivalent. They follow each other vertically in group IV of the periodic system of elements, and they both build oxydes (CO_2 and SiO_2) which react quite differently in building up larger compounds of molecules. Carbon's ability for double-binding cannot be found in silicium which is shown in the following comparison of the chemical formulas for ortho-carbonic acid and ortho-silic acid. By intramolecular splitting off of water, ortho-cabonic acid (a) becomes carbonic acid (b) and then dissociates into carbon dioxide. In the course of this process first one double bind is formed (b) and then two ensue (c).



As to ortho-silic acid we observe an intermolecular splitting off of water only between two molecules which then form the compound ortho disilic acid. Further condensation leads to structures that resemble chains, ribbons and petals. If the polymerization goes on even further the spacenetting structure of quartz (SiO_2) is reached. While CO_2 escapes from the porous system of the soil into the atmosphere, the highly polymer silicium molecules stay earthbound, massforming yet not inert. - There are parts which are very well equipped for catalysis, especially when the finest of mineral particles or those with lattice-disturbances are at work. HAMAKER and WEAVER in "The Survival of Civilization" (1982) for good reasons point out the importance of mechanical grinding by ice-age moraines as well as the effects of loess-drifts for soil-life and the development of vegetation. Their claim, we should imitate natural grinding and transport by technical measures to induce new pushes for the organic-mineral build-up of soil, seems pure logic.

If, between quartz-blocks and salt-ions in the soil solution, something which will be able to feed a manifold community of organisms is bound to develop, the structural elements of the colloidal sphere should lie between 100 Å and 2000 Å (0,002 mm). Colloids are higher ranking soil structures with a more luxurious energy-potential. Ground down, for example by glacier ice, rockdust will secure stability of the ecosystem soil wherever organic colloids join in. Organic colloids contain chemically bound sun-energy. Their own stability is high and, to a certain extent, they are able to stabilize mineral colloids, especially in the porous aggregate which is the conditio sine qua non of longevity and lasting fertility. If, on the other hand, acid immissions hit this subtle colloid system, the soil drifts into a dramatic situation with links between plant roots and colloidal particles getting lost.

As to organic colloids we should be aware that aromatic compounds are the most important. The "aromaticity" of cellulose by lignin has already secured the stability of woodplants, which would not have been achieved easily in unlignified cellulose. Without the incrustment of these durable phenolic substances, the first large-scale colonization of terrestrial biotopes would have gone into another direction. Ecosystems which are not only exposed to rain, snow, hoar-frost and especially storms but also display 75% of their biomass above ground, are in need of special physical properties to gain a secure footing and stability.

Also the second large colonization of further terrestrial biotopes by perennial grass species was the result of aromaticity. This time it was the soil itself that was aromatized by humic acids and clay-humus-complexes which can be very well observed in the chernozem. Perennial grass species deposit 75% of their biomass in a deeply penetrating root-system and produce the starting substance for the build-up of deep reaching black soil.

x x x

High soil quality is the result of functioning links. These links must not be categorized as static structural elements but we should become conscious of their dynamics on the molecular level:

o When weathering breaks stone structures in the soil, clay-minerals are formed which, in comparison with the initial material, show a different structure: we find more irregularities, more crystal water and a higher capacity for adsorbing H_2O. During formation of these colloids central cations with a different charge are built into the mineral structure in some cases. So Al^{3+} changes place with Si^{4+}; or Mg^{2+} substitutes Al^{3+}. The effect is a negative charge which is balanced by cations of positive charge in the surface- and intermediate layer areas of the colloids. In high quality soils these cations are Ca^{2+}, Mg^{2+} and K^+ which, by ion-exchange, are used up by soil-organisms or plant-roots. In acid soils H- and Al-ions become factors of grave disturbances; they are no longer able to serve the formation of links, and soils desintegrate.

o Wherever soils gain their inner consistency by sticky wrappings from bacteria and blue-algae or by threadlike growing actinomycetes and fungi, we owe this to the dynamics of the colloidal structure of organisms. Vitality is the result of their functioning on a high level of energy. Wherever these links are missing, reduction of vitality follows immediately.

o The earthworm has to be recognized as one of the most effective linking-devices for soils. Massive flow of organic and mineral substances make its way through the intestines of the earthworm and are turned into clay-humus-complexes. The deeply penetrating burrows of the earthworm allow for gas-exchange with the atmosphere and roots reaching down into greater depths. The finest roots preferably penetrate soil-particles which have gone through the earthworm passage.

o While the building up of colloids is the basis for the linking system, roothairs in interaction with capilary water are the basis for the exchange between soil colloids and plants. In high-acidity soils water vanishes with the breakdown of links.

o Links most endangered nowadays by acidity are the mykorrhiza-fungi which supply water and mineral nutrients in symbiosis with the roots of forest trees. The mykorrhiza has to rely on the supply with sugar by the tree. If this flow is cut off by deficiency- and reduction processes, the mykhorriza dies. This is what "Waldsterben" boils down to: a disintegration of links with the colloidal system and consequently the degradation of the colloidal system itself which could be called the heart of life on this globe.

x x x

When forests die, biotopes vanish; cultures degenerate and man faces the end of his endeavors. The ongoing CO_2 drama is closely linked with dying forest ecosystems. While CO_2 absorption by the oceans is possible in large quantities, it is always a slow process. In comparison forests show a much higher potential to absorb CO_2 quickly but, on the other hand, they give it back to the atmosphere suddenly when forest fires occur. Upset of the CO_2 balance has accured since the tertiary period when plant covers reached their largest expansion: by the end of the tertiary period a slow cooling process set in, which, in the quaternary period, became part of a pattern: periodic climatic changes. There is ample evidence that CO_2 as an indicator for the efficiency of vegetation cover played and still plays its role in the development of cooling.

HAMAKER and WEAVER have offered important material for the understanding of the CO_2 problematique, especially by stressing the tectonic factor. For my understanding there was still one missing link which has now been delivered by Matthias Kuhle's work on "The glaciation of Tibet and the development of glacial periods". Kuhle states that in the tertiary period the Indian subcontinent starts to slide down under the eurasian landmasses by heaving up the Highland of Tibet. When in humid climate demineralisation by leaching starts under natural conditions, CO_2 rises. Rain, snowfall and albedo effects become more frequent in those parts of Tibet where it emerges from tropical zones with Monsunrains. Climatic stability is upset more and more: In biotopes which up to now absorbed sunrays and thus retained the warmth , suddenly snowcovers stay permanently and reflect the sunrays back into space. According to Kuhle at this point ice-age starts in this part of the world and comes to its end only after icecovers nearer the poles which have been formed at a later date, melt.

With CO_2 rising dramatically, evidence points to a new ice-age period approaching rapidly. It will need all our courage, knowledge and joint global activity, to slow down the impact. The starting point must be the build-up of the linkage system of soils: Man is still the missing link in the re-structuring of the biosphere he is in danger to destroy.

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SECTION 3: DECISION THEORY APPROACH (CANARY)

DECISION FACILITATORS: Development of people with skills in aiding decisionmaking under uncertainty where incomplete data is available. Development of techniques to estimate the risk of waiting for complete scientific proof.

Sec. 3.0 World Problems Plotted by Intensity vs. Time to Go Critical

TABLE I. MAJOR WORLD PROBLEMS.
Classification of problems and crises by estimated time and intensity.

Grade	Estimated crisis intensity: Numerical (number affected times degree of effect)	Descriptive (word description)	Estimated time to crisis: <1 to 1 years	1 to 5 years	5 to 20 years	20 to 50 years	50 to 1000 years	Grade
1.	10^{10}	Total annihilation		Nuclear or BCW escalation	NUCLEAR OR BCW ESCALATION	(Solved or dead)		1.
2.	10^{9}	Great destruction or change (physical, biological, or political)		NUCLEAR WINTER	NUCLEAR WINTER Famines Ecological balance Development failures Local wars	Economic structure and political theory Population and ecological balance Patterns of living		2.
					CARBON DIOXIDE, GLACIATION, DESERTIFICATION, OZONE DEPLETION?, [illegible]	BC('77) Kukla et al: New cooling data. BC('79): Woillard Abrupt end of last interglacial (20 y).	BC('72) Kukla et al: End of interglacial a few 100 yr.	
			HNC('81) Hamaker Drought, famine & death in Africa. We can still influence cycle with remineralization & reforestation.	HNC('82) Hamaker Critical point of glaciation process 198x.	HNC('86) Hamaker Temperate zone gone in 1995. Few people alive in 1995.			
				ACID RAIN	[illegible] gap	Universal education Communications-integration Management of world Integrative philosophy		
3.	10^{8}	Widespread almost unbearable tension		Administrative management Need for participation Group & racial conflict Poverty-rising expectations Environmental degradation	Poverty Pollution Racial wars Political rigidity Strong dictatorships	COMPUTERIZED DESTRUCTION OF WESTERN CIVILIZATION		3.
4.	10^{7}	Large scale distress		Transportation Diseases Loss of old cultures WOMEN'S RIGHTS	Housing Education Independence of big powers Communications gap NEED FOR GENERAL SYSTEMS LEADERSHIP AT ALL LEVELS	CARBON DIOXIDE, CLIMATE WARMING, SEA LEVEL RISE. (NRC'83) (EPA'83)		4.
5.	10^{6}	Tension producing responsive change		Regional organization Water supplies OCEAN FLOOR MINING UNITED NATIONS LAW OF THE SEA				5.
6.		Other problems--important, but adequately researched		Technical development design Intelligent monetary design				6.
7.		Exaggerated dangers and hopes				Eugenics		7.
8.		Noncrisis problems being "overstudied"		Man in space Most basic science				8.
			<1 to 1 years	1 to 5 years	5 to 20 years	20 to 50 years	50 to 1000 years	

VALUES IN DECISION MAKING ON WORLD PROBLEMS.

Fred Bernard Wood
Computer Social Impact Research Institute, Inc.
2346 Lansford Ave., San Jose, CA 95125, 408/269-9327

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.

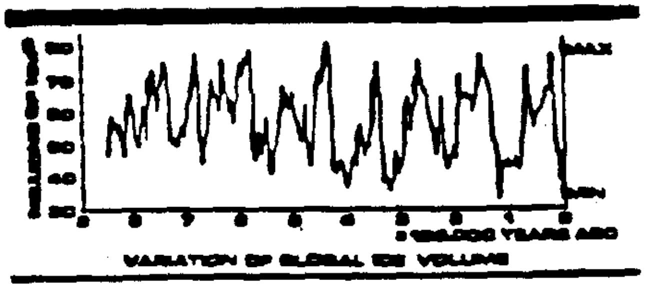
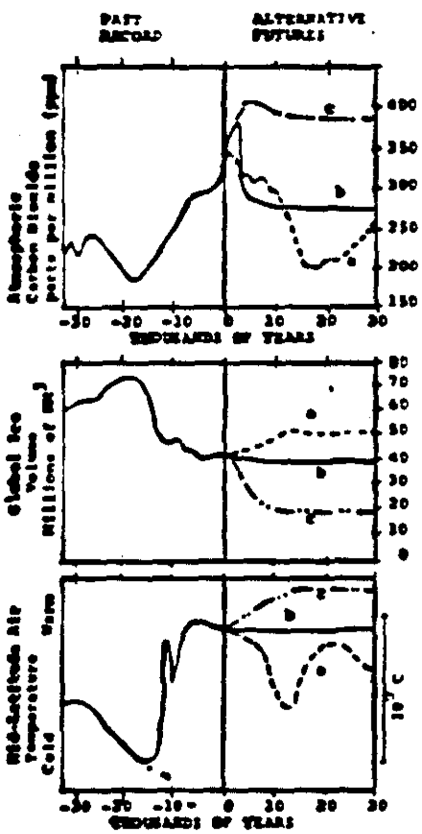


Fig. 1



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 2: REGRET MATRIX FOR CLIMATE CHANGE

Estimated number of people dying from starvation on planet Earth from 1988 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 1988 TO 1995		
	a GLACIATION INCREASING NOW	b GLACIATION REMAINING AT PRESENT LEVELS	c 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.

Sec. 3.3 STRATEGY FOR COEVOLUTION: Since both the naturally occuring cycles of glaciation and man-made polution of the environment lead to 20% to 50% decreases in the food supply on our planet we have to develp some strategy to deal with the loss of a large part of our food supply. The Hamaker Thesis indicates urgency, but does not have precise scientific proof of the loss of our food supply in a few years. We must take preventive measures so that we will not "regret" having known about a danger to civilization without doing anything about the danger. We have to simultaneously deal with problems from six different approaches. We also have the problem of matching the scientists and philosophers to the parts of the problem urgently needing their skills. These six approaches are:

Philosophical Oversight,
Engineering Synthesis,
Scientific Research,
Education,
Decision Under Uncertainty,
and Emergency Action.

At the same time we have to prepare plans of action for:

The United Nations,
Individual Nations,
  First World,
  Second World,
  Third World, and
  Fourth World,
Multi-National Corporations,
Government Agencies,
States,
Political Organizations,
Community Groups, and
Individuals.

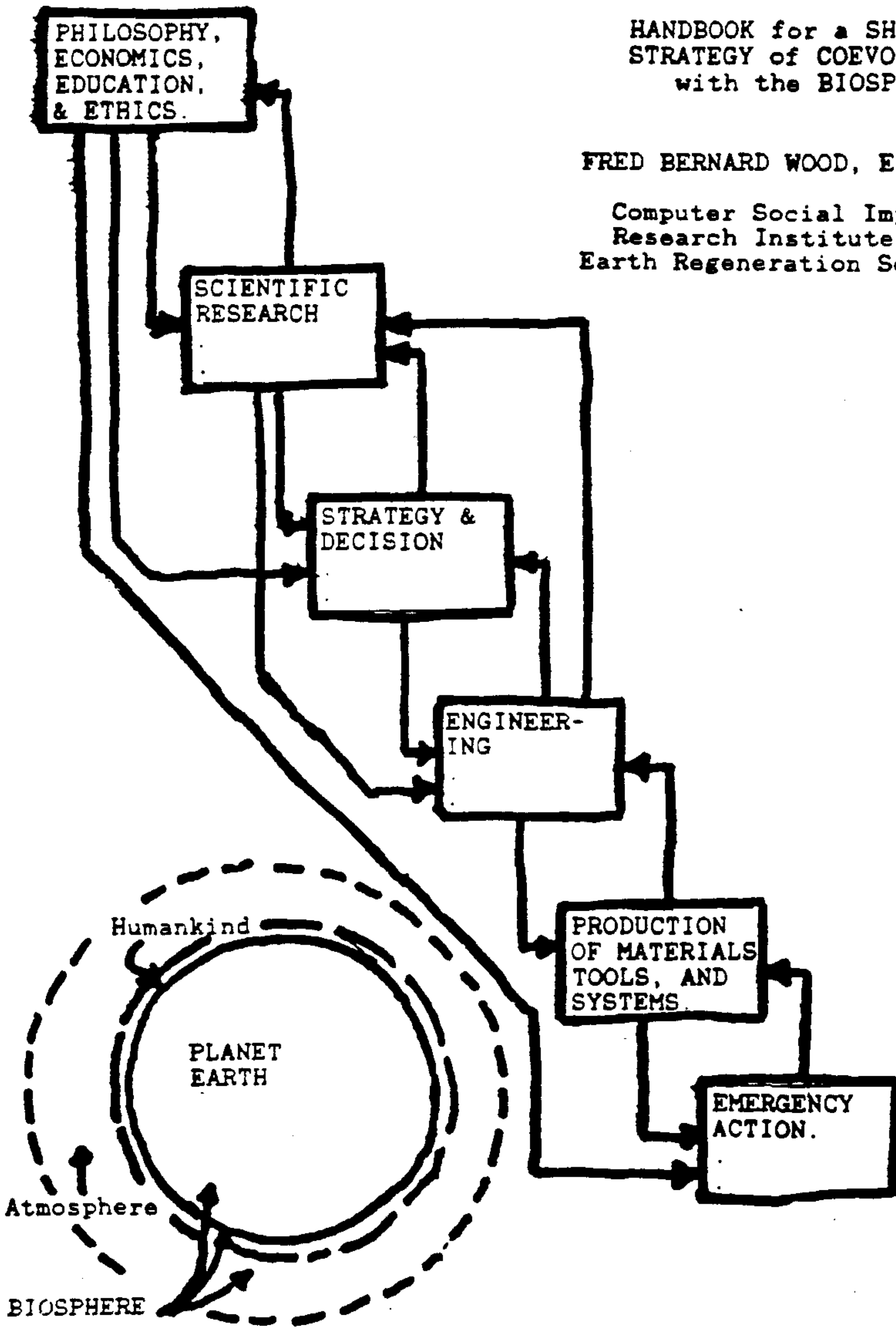
Here we have the problem of facilitating individuals to move to their maximum level of competance, and providing simple projects individuals can do on their own when frustrated by failure of hiher level organizations to take responsible action.

We first make a matrix from the above factors to facilitate keeping track of where we are in our task.

HANDBOOK for a SHAREABLE STRATEGY of COEVOLUTION with the BIOSPHERE.

FRED BERNARD WOOD, Editor

Computer Social Impact Research Institute and Earth Regeneration Society.



STRATEGY MATRIX

	A	B	C	D	E	F
	PHILO-SOPHI-CAL OVER-SIGHT.	ENGIN-EERING SYNTHE-SIS.	SCIEN-TIFIC RESEAR-CH	EDUCA-TION.	DECI-SION UNDER UNCER-TAINTY.	EMER-GENCY ACTION.
1.UNITED NATIONS->						
INDIVIDUAL NATIONS						
2. FIRST WORLD ->						
3. SECOND WORLD ->						
4. THIRD WORLD ->						
5. FOURTH WORLD ->						
6.MULTI-NATIONAL CORPORATIONS ->						
7.GOVERNMENT AGENCIES ->						
8. STATES ->						
POLITICAL ORGANIZATIONS						
9. POLITICAL PARTIES ->						
10. PEACE GROUPS->						
11. WOMEN'S GROUPS ->						
12. ENVIRONMENTAL GROUPS ->						
13.CHARITABLE FOUNDATIONS ->						
14. SCIENTIFIC SOCIETIES ->						
15.CITY & COUNTY AGENCIES ->						
16.COMMUNITY GROUPS ->						
17. SMALL BUSINESSES ->						
18. INDIVIDUALS ->						

STRATEGY MATRIX

	A	B	C	D	E	F
	PHILO-SOPHI-CAL OVER-SIGHT.	ENGIN-EERING SYNTHE-SIS.	SCIEN-TIFIC RESEAR-CH	EDUCA-TION.	DECI-SION UNDER UNCER-TAINTY.	EMER-GENCY ACTION.
1. UNITED NATIONS ->						
INDIVIDUAL NATIONS						
2. FIRST WORLD ->						
3. SECOND WORLD ->						
4. THIRD WORLD ->						
5. FOURTH WORLD ->						
6. MULTI-NATIONAL CORPORATIONS ->						
7. GOVERNMENT AGENCIES ->						
8. STATES ->						
POLITICAL ORGANIZATIONS						
9. POLITICAL PARTIES ->						
10. PEACE GROUPS ->						
11. WOMEN'S GROUPS ->						
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14. SCIENTIFIC SOCIETIES ->						
15. CITY & COUNTY AGENCIES ->						
16. COMMUNITY GROUPS ->						
17. SMALL BUSINESSES ->						
18. INDIVIDUALS ->						

Use of the Strategy Matrix

The plan is to use the matrix on the left to plan the sequence of actions with different groups using different approaches. Symbols and dates can be placed in the matrix, with detailed notes identified by the symbols to be included on this and following pages.

SECTION 4 ENGINEERING APPROACH (BLUE)

ENGINEERING SYNTHESIS: Development of an adequate synthesis of concepts from over 25 fields of science and 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 cooperation between the specialists in the different fields and the generalists.

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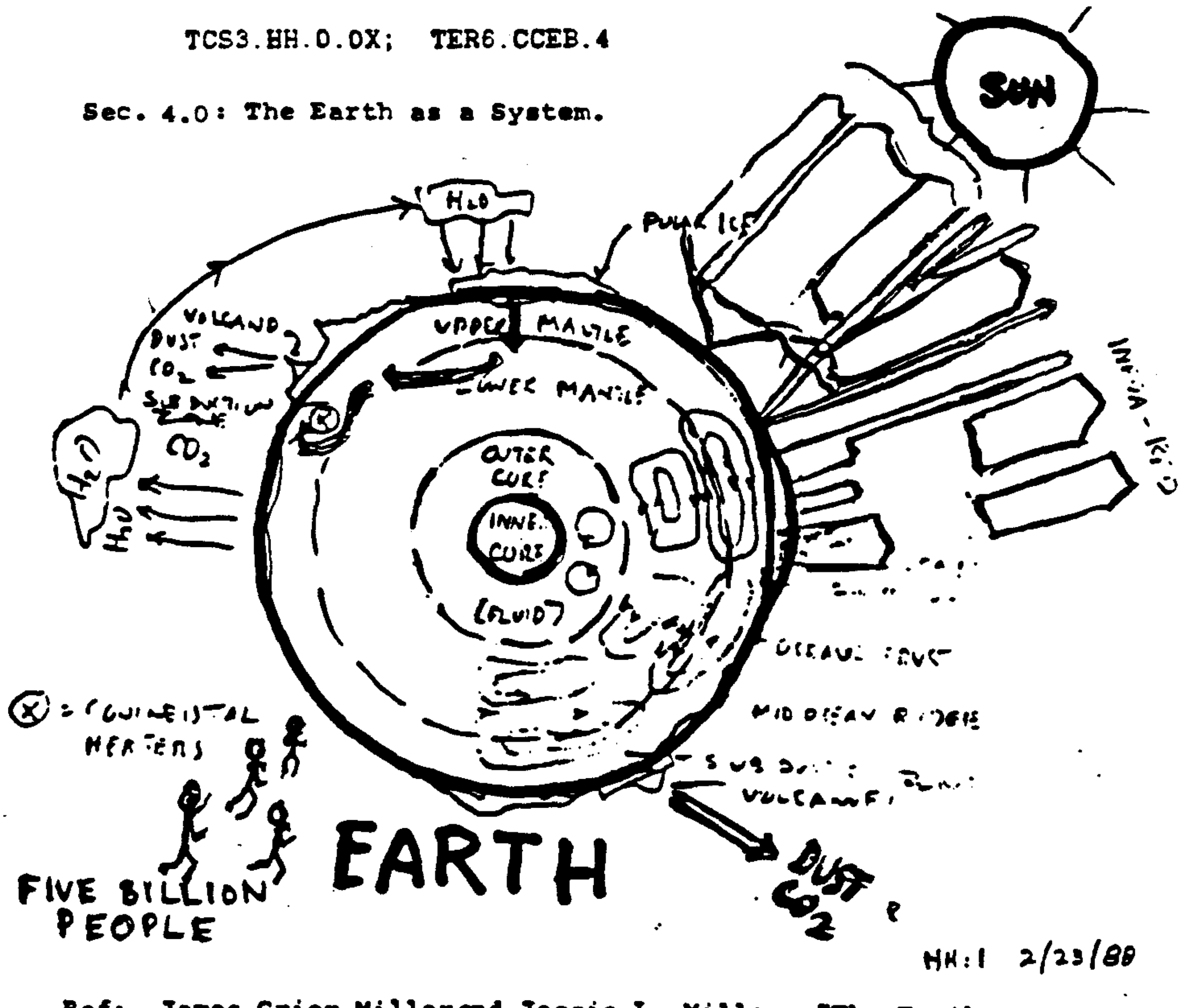
Sec. 4.0: The Earth as a System.



Ref: James Grier Miller and Jessie L. Miller, "The Earth as a System." Behavioral Science, Vol. 27, No. 4, Oct 1982, pp. 303-322.

Section 4.1

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

John Hamaker, Mechanical Engineer
Rte. 1, Box 158
Seymour, MO 65746, 417/935-2116

Don Weaver, Ecologist, & Editor of
SOLAR AGE or ICE AGE? BULLETIN
138 Valdeflores Dr.
Burlingame, CA 94010, 415/342-0329

ABSTRACT

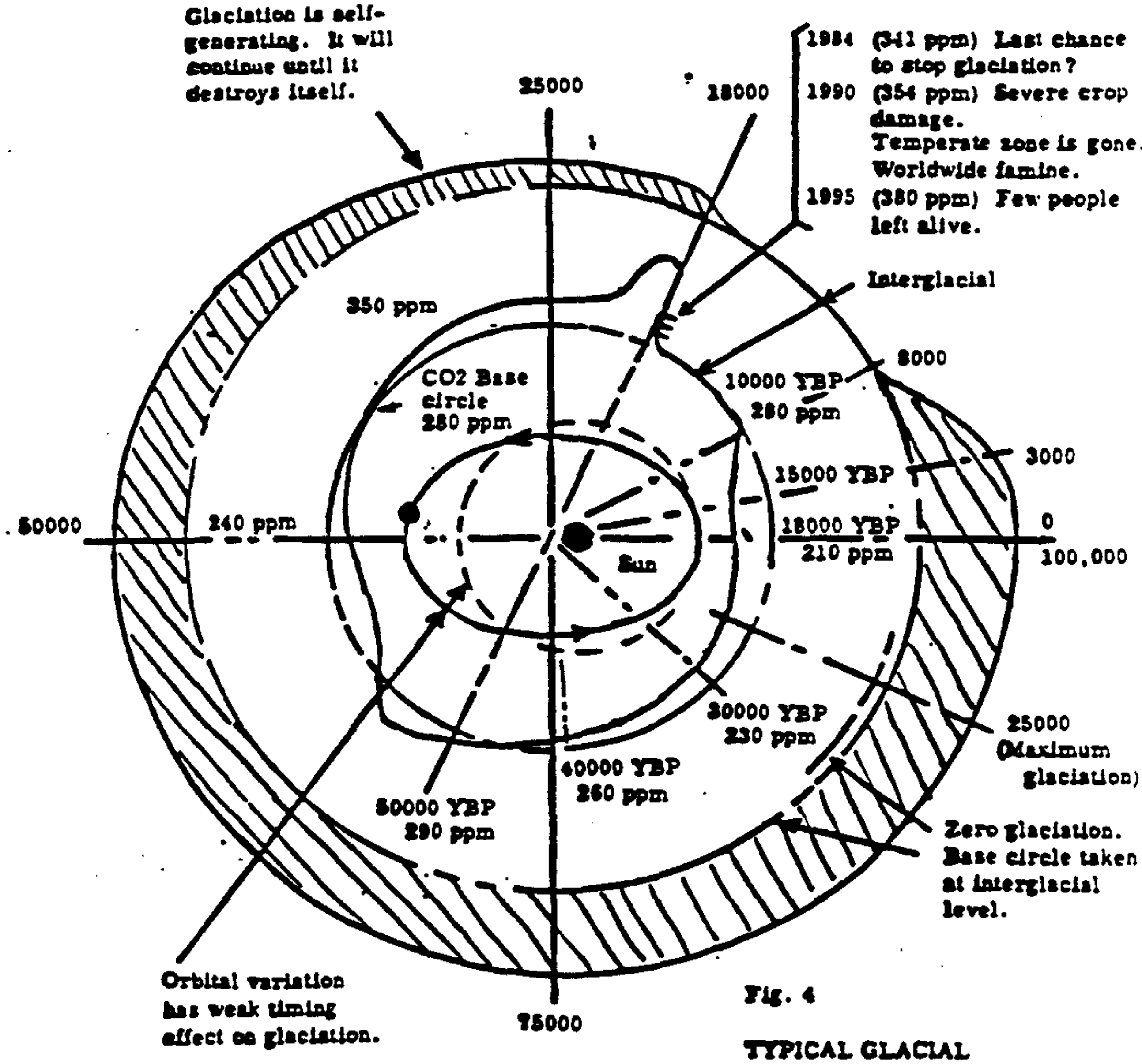


Fig. 4

TYPICAL GLACIAL CLIMATE CYCLE

The book, The Survival of Civilization (Hamaker and Weaver, 1982), is a Thesis on how the 100,000 year Glacial-Interglacial Cycle works: demineralization of the soil; deforestation; rising carbon dioxide in the atmosphere; increased moisture evaporated by greenhouse 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 to permit the growth of the ice sheets. 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 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.

The entire climate cycle can be controlled at interglacial conditions 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

Gregory Watson

Executive Office of Economic Affairs
and
Department of Food and Agriculture
Commonwealth of Massachusetts
Boston, Massachusetts 02108

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 (CO_2). He argues that CO_2 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 contributes 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 regenerative 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."

ENGINEERING PHILOSOPHY OF COMBINING TOP-DOWN AND BOTTOM-UP SYSTEMS ANALYSES OF CLIMATE CHANGE.

FRED B. WOOD, Sr. (or III)
2346 Lansford Ave.
San Jose, CA 95125 USA
(408) 723-7818

Abstract

The problem is what is happening to the climate, and what can we do about it to preserve the food supply for the five billion people who inhabit the Earth?

Philosophy. Using both a top-down and a bottom-up approach to the climate change problem, we predict that the elapsed time to solve the problems of climate change could be reduced by breaking the problems up into six section.

Science. From the Science perspective, we review the structure of cycles of ICE ERA's, ICE EPOCH's, ICE AGE CYCLES, INTERGLACIAL WARM PERIODS, and LITTLE ICE AGES. We identify numerically which ERA, EPOCH, CYCLE, and PERIOD we are in, and translate both the simple greenhouse warming thesis and the soil nutrition glacial cycle thesis into terms of where are we on the levels of glaciation time charts.

Decision & Strategy. This discussion leads to the need for people concerned over the environment and climate change to develop three types of consciousness: Individual, Social and Geophysical. These form a triple pentagon for coevolution with the biosphere.

Engineering. This section includes a comparison of present temperature data with trends predicted by the nutrition-glacial cycle thesis.

Production. This discussion accounts for the materials needed for reforestation and remineralization such as seedlings and rock dust, and the equipment needed such as tree planting machines and rock grinders plus alternative energy technologies.

Emergency Action. This discussion relates to calculations of the rate of reforestation needed to reduce the CO/2 level fast enough to prevent world-wide crop losses that would bring massive starvation to our planet.

Philosophy

Using both a top-down and a bottom-up approach to the climate change problem, we predict that the elapsed time to solve the problems of climate change could be reduced by breaking the problems up into six sections described above. From the Philosophy perspective, we review thirteen different hypotheses on climate change, not just the simple greenhouse warming thesis. These alternative hypotheses and the forty-five experiments against which they should be checked are listed in the 1987 ISGSR Conference Proceedings [19].

Science.

Glaciation History

What does science tell us about the current climate change? The history of ice ages on planet Earth is summarized in Fig. 1, which is based on an illustration in the Time-Life Series [4]. In terms of Glaciation Cycles:

We are near Year 10,800 of
the 23-rd Inter-Glacial WARM PERIOD of 10,000-12,500 years of
the 23-rd 70,000-120,000 year ICE AGE cycle in
the 6-th ICE EPOCH of 2 million-4 million years of
the 7-th ICE ERA of 65 million-100 million years in
the 4.6 billion years of Planet Earth.

Top-Down

From the Science perspective, we review a Top-Down approach to understanding the structure of the ice age cycles. Even if one believes that the greenhouse warming will cancel out the ice age cycles, one needs to show a functional diagram and/or sample calculations of the process. The cycles of ICE ERA's are shown with more scientific details in the Cambridge Encyclopedia [11].

The next step in developing a more comprehensive top-down analysis would be to develop a one-dimensional simulation of the climate system starting with the block diagram suggested by Fred B. Wood, Jr. [17]

Bottom-Up

The Bottom-Up approach starts with physical properties such as the gas molecules of the atmosphere, the water in the oceans, and the land masses. The computer simulations of climate have progressed from energy balance climate models to one dimensional radiative-convective climate models to two-dimensional climate models to three-dimensional general circulation climate models. Then computer simulation programs are written to connect everything together and to make computer runs of the simulation programs to see what happens as the atmospheric carbon dioxide quantity is increased [9].

American Society for Cybernetics Criterion

For a number of years the American Society for Cybernetics has maintained a rule that a reliable computer simulation of a system should have at least two different types of simulation models to compare before one can consider either one of them reliable. What is lacking in the simulation of climate change is existence of two sufficiently different simulation approaches to meet this criterion. A simple one-dimensional top-down simulation of the climate system including the soil minerals, trees, and other vegetation would be an important step toward testing the current models against this criterion.

Decision & Strategy.

This discussion leads to the need for people concerned over the environment and climate change to develop three types of consciousness: Individual, Social and Geophysical. These form a triple pentagon for coevolution with the biosphere as shown in Fig. 2.

Individual Consciousness

For the individual to be effective, either doing research on climate change, or as a political activist taking emergency action, he or she must review a number of areas within the scope of his or her individual consciousness: Ethics; Sub-Conscious Script [10]; Nutrition & Exercise; Psychological Awakening; Resolution of Codependency.

Social Consciousness

For groups of people to develop a successful political action plan for the protection of the environment, for climate stabilization, or for a more narrow sphere of interest such as women's rights, they need to understand a group of social concepts such as: The Partnership Way [5,6] (Male & Female Cooperative decision Making); Business Decision Theory including the Regret Matrix [21]; Reconstructive Knowledge [22]; Cooperation between Nations through the UN and UNEP; and the Perception of Tools of Production.

It is particularly important for special groups such as those working for women's rights develop a Geophysical Consciousness to enable them to understand how climate change could disturb the social institutions that protect their rights.

Geophysical Consciousness

Alden Bryant has defined the "Environmental Pentagon" [3] as the five major components of climate change: Soil, Forests, CO/2, Oceans and Ice.

Engineering.

There has been discussion as to whether the Hamaker Thesis on Soil-Nutrition Driven Glacial Cycles should go in the science or engineering sections. It now appears that it should be treated in both sections. The Hamaker Thesis is a science hypothesis in which parts are still in the qualitative stage of development that makes it difficult to apply the usual quantitative tests in testing scientific hypotheses. However the Hamaker Thesis is valuable as an engineering guide in estimating possible future states of nature to use in business management type decision theory under uncertainty.

This section includes a comparison of present temperature data with trends predicted by the nutrition-glacial cycle thesis. In Fig. 3 the top right square (D) shows that we have ten years of satellite microwave sounding unit measurements of the Earth's surface temperature [8]. Since there is an irregular cyclic variation of varying period from ten to fifteen years it may take thirty years of data to obtain proof of whether it is warming or cooling directly from surface temperatures.

Even though there are questions about the proper placing of thermometers, the 100-year temperature data can help us see where are. In Fig. 3 for Northern (A), Tropic (B), and Southern (C) latitudes the solid curves are the five-year running means of surface temperature anomaly. For the recent part of curve A the annual mean values are plotted as dots.

Examining the dots for the last thirty years shows that the annual mean temperatures are becoming very irregular, while in 1955-1960 the annual and the five-year running mean values were very close. It is known that many records for hottest and coldest temperatures in 100 years have been broken in the last few years. There are signs that the greenhouse warming effect is storing more energy in the atmosphere which may be leading to more non-linear chaotic processes not predictable by our present computer simulation programs.

The long straight lines are straight line approximations to the five-year running mean lines. The long dash lines are predictions made by Hamaker in 1983 [7] on the basis of the Hamaker Thesis. The scatter of the annual mean dots tend to show a slight warming, but this warming is still within the ten to fifteen year variation in temperature from unidentified sources. In twenty years we should have accurate data on where the earth surface temperature is going.

Research by Woillard in France has shown that the previous transition from interglacial warm zone vegetation to arctic vegetation occurred in less than twenty years [14]. If we wait for verification of the cooling associated with glaciation, we may wait until it is too late to stop the glaciation and two or three billion people could die of starvation on our planet.

Therefor I recommend that we move at full speed to reforest the earth, remineralize the soil, reduce the burning of fossil fuels, and convert to alternative energy sources such at thermal electric power plants.

Production.

This discussion accounts for the materials needed for reforestation and remineralization such as seedlings and rock dust, and the equipment needed such as tree planting machines and rock grinders plus alternative energy technologies. Potential sources of rock grinders and other materials are reported in the newsletter: Soil Remineralization [12].

Emergency Action.

This discussion relates to calculations of the rate of reforestation needed to reduce the CO/2 level fast enough to prevent world-wide crop losses that would bring massive starvation to our planet. Alden Bryant has prepared reports on possible rates of reforestation and compared the results with the rate of which the CO/2 is rising [2,3].

Conclusions

Engineering, Production, and Emergency Action components of the program lead to the conclusion that even the opposing groups of environmentalists can agreed on a common plan of reforestation, stopping the logging of tropical and temperate rain forests, stopping the burning of fossil fuels, developing of alternative energy sources, remineralization of the soil, etc.

References: A very abridged reference list is printed below. The full reference list is available from the author.

[1] Bryant(1987)
[2] Bryant(1989)
[3] Bryant(1990)
[4] Chorlton(1983)
[5] Eisler(1987)
[6] Eisler(1990)
[7] Hamaker(1983)
[8] Hansen(1988)
[9] Henderson-Sellers(87)
[10] Kappas
[11] Smith(1982)
[12] SR
[13] Spencer(1990)
[14] Woillard(1979)
[15] Wood,Jr(1988)
[16] Wood,Jr(1988)
[17] Wood,Jr(1989)
[18] Wood,Jr(1990)
[19] Wood,Sr(1987)
[20] Wood,Sr(1990)
[21] Lial(1974)
[22] Raskin(1987)

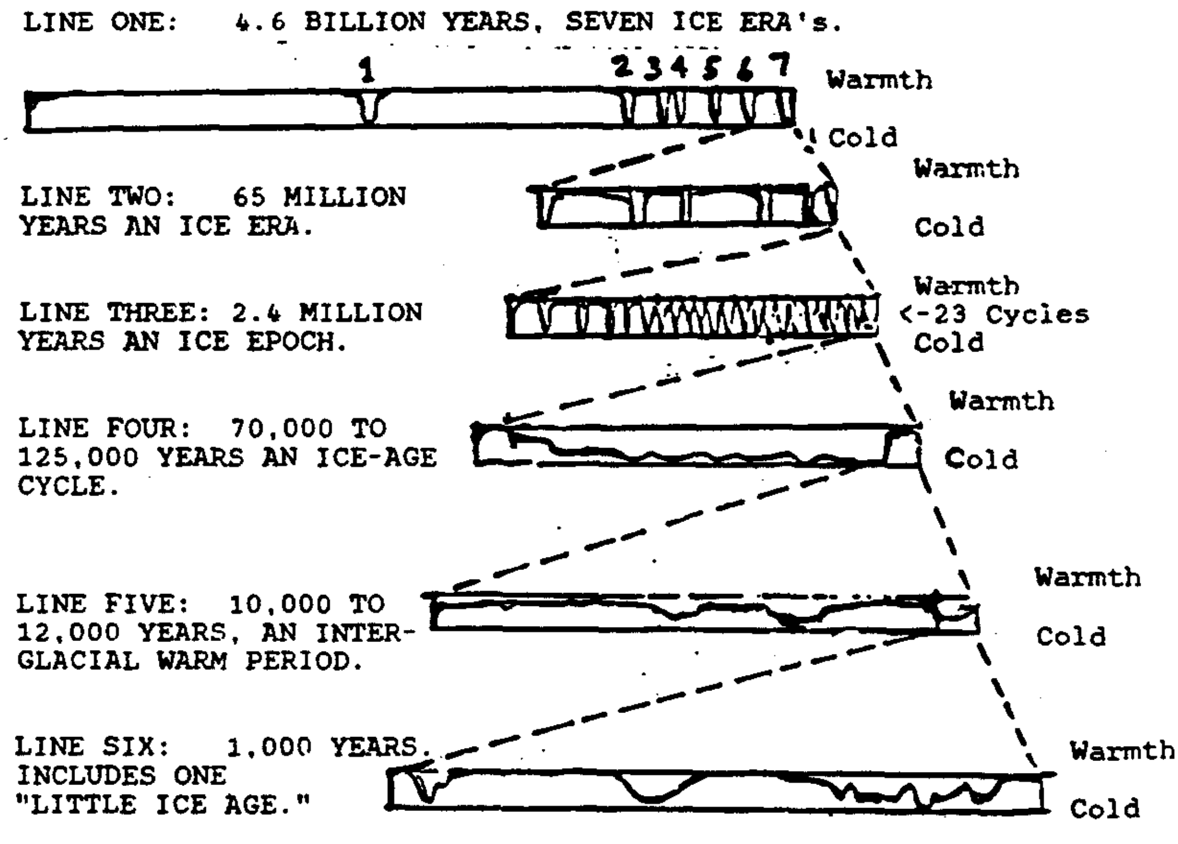
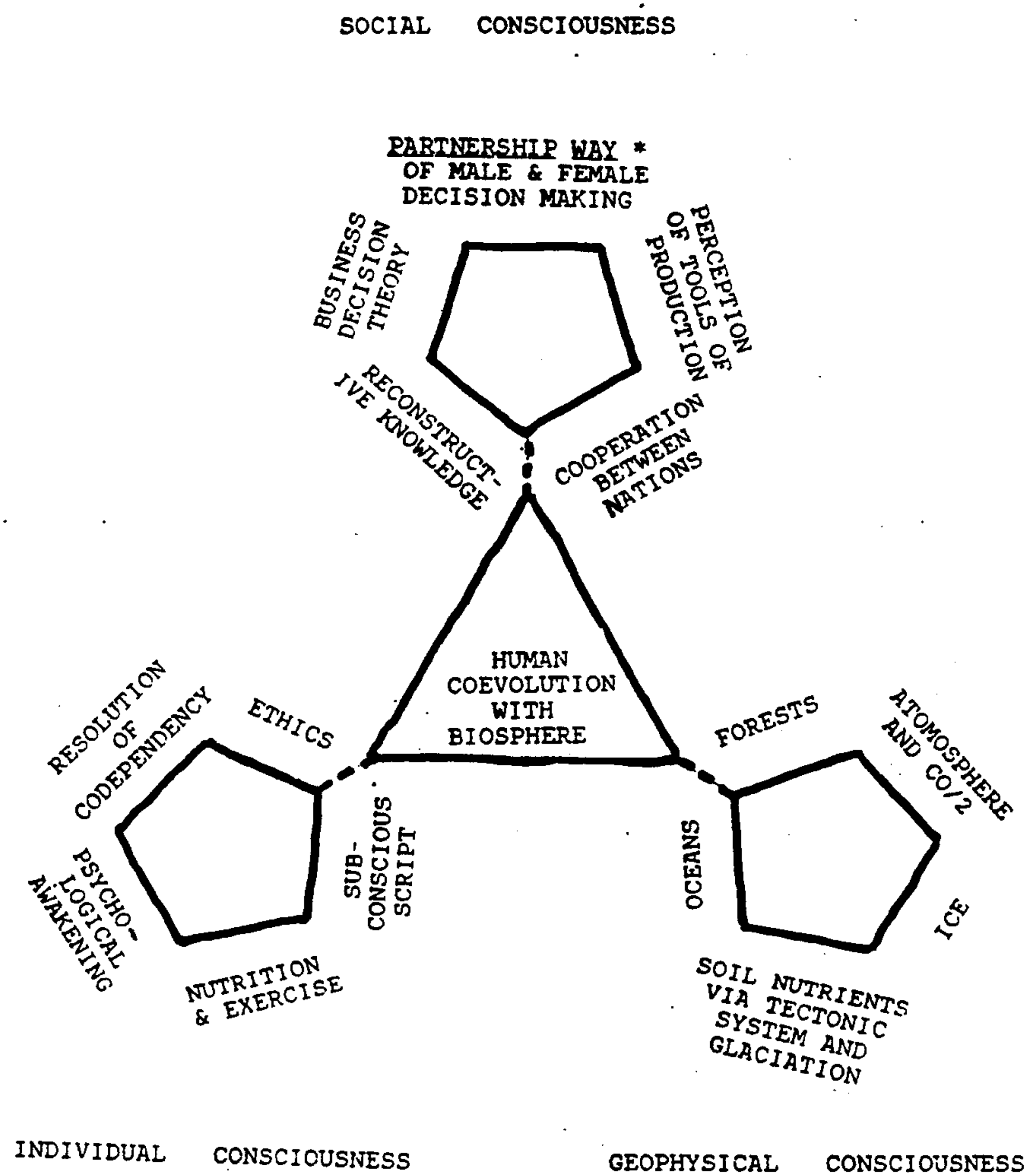


Fig. 1. A series of time charts, each one embracing a fraction of the one above, depicts the swings between cold and warmth that have characterized the climate of the earth for billions of years. Adapted from Chorlton and Editors of Time-Life Books [ ].



* Riane Eisler, The Chalice and the Blade (1987)
Riane Eisler & David Loye, The Partnership Way (1990)

Fig. 2. Triple Pentagon for Human Coevolution with the Biosphere.

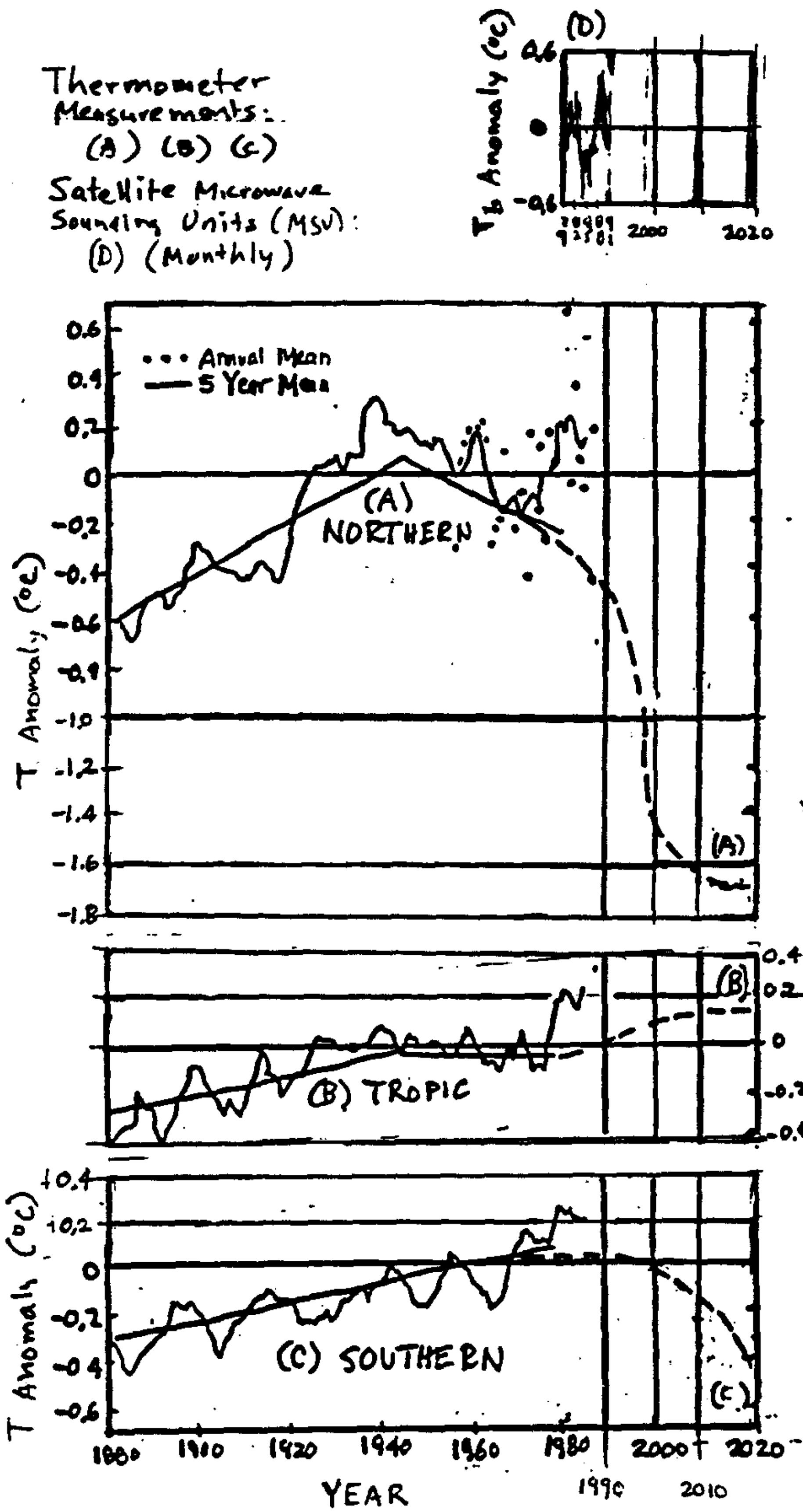


Fig. 3. Hansen's data [8] on Temperature Anomaly from 1880 to 1987: (A) for Northern Latitudes (90 N 23.6 N), (B) for Tropic Latitudes (23.6 N to 23.6 S), (C) for Southern Latitudes (23.6 S to 90 S). Hamaker's projections [7] of these temperatures for 1970 to 2020 shown in dashed lines. Spenser and Christy's satellite microwave sounding unit data [13] for 1979 to 1989 added at top.

SECTION 5: PRODUCTION OF MATERIALS, TOOLS, AND SYSTEMS. **(TAN)**

Materials Needed to help reduce the carbon dioxide level in the atmosphere:

Rock dust for remineralization.

Tree seeds and seedlings.

Tools neded for the project:

Rock grinders to produce gravel dust.

Tree planting machines to speed up the reforestation work.

Systems needed to help in the work:

A method of computing carbon dioxide budgets for individuals, families, neighborhoods, cities, counties, states, countries, and the United Nations.

Computer simulation systems for analysing the climate system.

For information on rock dust and rock grinders see Soil Remineralization A Network Newsletter, 3 to 4 issues per year. Send &12 for subscription to:

SR
152 South Street
Northampton, MA 01060

For an outline of a carbon dioxide budget see next page. Further details available from :

Earth Regeneration Society
1442A Walnut Street, #57
Berkeley, CA 94709
(415) 525-4877

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EMERGENCY ACTION

SECTION 6: EMERGENCY ACTION APPROACH: Development and carrying out emergency programs such as remineralization and reforestation to stabilize climate.

A SCORECARD TO HELP THE INDIVIDUAL ACCOUNT FOR HIS SHARE OF RESTORING THE EARTH AND DEVELOPING LEVERAGE WITH THE POLITICAL SYSTEM

A=North America B=South America C=Europe
D=Soviet Union E=China F=S.E. Asia
G=Africa

...	REFOREST-ATION	REMINERAL-IZATION	STOPPING FOSSIL FUEL BURNING	ALTERNATIVE ENERGY SOURCES	
UNITED NATIONS					A B C D E F G
NATIONS					A B C D E F G
MULTI-NATIONAL CORPORA-TIONS					A B C D E F G
STATES					A B C D E F G
INDIVIDUALS					A B C D E F G

It is proposed "SCORECARDS" be maintained to show how each group, by geographical location, level in the hierarchy, and segment of the problem is doing. If individuals and small groups do their proportionate part of say, reforestation, then they can put pressure upon the higher levels of organization to do their part.

WHAT ARE THE SOLUTIONS ?

Simply, a full worldwide, maximum effort on an earth regeneration program.

An earth regeneration program means:

*** STOP DEFORESTATION

Forests are being destroyed at a rate equivalent to losing the size of the country of Austria every year, and this rate is increasing. This process releases carbon into the atmosphere and reduces the ability to balance CO/2 in the atmosphere through photosynthesis.

*** STOP BURNING FOSSIL FUELS. AND FIND NON NUCLEAR ALTERNATIVES

Coal, oil and gas, when burned, release CO/2 into the atmosphere. CO/2 is being put into the atmosphere through burning fossil fuels at an alarming rate.
Nuclear alternatives are not acceptable to this organization nor the health and welfare of the people of the world.

*** REFOREST AT THE RATE OF 500,000 SQUARE KILOMETERS OF NET GROWTH PER ANNUM FOR THE NEXT 30 YEARS.

To reduce CO/2, photosynthesis must be increased. A net increase in forest growth of 500,000 square kilometers for 30 years should pull enough carbon out of the atmosphere to return the CO/2 levels to well under 300 parts per million.

*** REMINERALIZE THE SOILS OF THE EARTH TO RESTORE THE HEALTH OF THE SOILS, SOIL ORGANISMS AND THEN THE TREES.

A glacial cycle remineralizes the soils over a long period of time. This is accomplished through glacier movements and wind blowing of glacial dust. Volcanic activity spreads minerals throughout the world. (Mt. St. Helens sent volcanic dust throughout the world as do all volcanoes.) Volcanic activity is greatly increased during a glacial period.

What must be accomplished is to artificially remineralize the earth. Not much rock dust per acre is needed. A number of countries and individuals in many more countries including our own, are already doing this on increasingly larger scales. This effort restores the mineral balance to the soils. This improves the survival ability of micro-organisms, the soils and consequently the trees.

- end

Sec. 6.1

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

Dr. Julianne Malveaux, Economist
Alden Bryant, President
Earth Regeneration Society, Inc.
470 Vassar Avenue, Berkeley, California 94708

ABSTRACT

5/26/86

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 fisheries	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 data for input-output industries — output, price, and employment (1972-SIC definitions). The estimates are those of the author.

Section 6.2: Local Action Plans in Cochabamba, Bolivia.

The following is a transcription of a speech by Dr. Fred Bernard Wood to the City Council of Cochabamba, Bolivia, on July 27, 1990. (File No. A-1135)

Honorable Licendiado Carlos Quiroga Blanco, Members of the Municapal Council of Cochabamba, and othr guests: Thank you for inviting me to be your guest of honor. Although I have been involved inthe development of advanced communication technology for several decades, since 1957 - and very intensively since 1982 - I decided to work on problems of global climate instability because of its enormous threat to life on this planet.

**HONORABLE LIC. CARLOS QUIROGA BLANCO, MIEMBROS DEL CONSEJO MUNICIPAL DE COCHABAMBA, DISTUINGIDA CONCURRENCIA: LES AGRADEZCO POR DECLARARME HUESPED DE HONOR DE COCHABAMBA. AUNQUE ES CIERTO QUE POR DECADAS MI TRABAJO CONSISTIO EN CONTRIBUIR AL DESARROLLODE SYSTEMAS AVANZADOS DE COMUNICACIONES, DESDE 1957 Y MUY INTENSAMENTE DESDE 1982, MI TRABAJO SE CONCENTRO EN ASPECTOS DE INESTABILIDAD CLIMATICA GLOBAL, DEBIDO AL ENORME PELIGRO QUE REPRESENTA TAL FENOMENO PARA LA VIDA EN ESTA PLANETA.

I am pleased that the World Emergency Campaign for Global Climatic Stabilization that was launched by Bolivia in 1989, was conceived in Cochabamba. I understand that the Cochabamba group of that campaign, is in the process of developing its carbon dioxide budget; this effort will be a very important event to show the country and the United Nations what one city can do without waiting for the rest of the world.

**ES UNA GRAN ALEGRIA PARA MI SABER QUE LA CAMPANA MUNDIAL DE EMERGENCIA PARA LA ESTABILIZATION CLIMATICA GLOBAL QUE FUE LANZADA POR BOLIVIA EN 1989, PRACTICAMENTE SE CONCIBIO EN LA CIUDAD DE COCHABAMBA. ENTIENDO QUE LA REGIONAL DE COCHABAMBA DE DICHA CAMPANA ESTA EN EL PROCESO DE DESARROLLAR SU PROPIO BALANCE DE DIOXIDO DE CARBONO; ESTE ESFUERZO SERA MUY IMPORTANTE PARA DEMOSTRAR A VUESTRO PAIS Y A LAS NACIONES UNIDAS LO QUE UNA CIUDAD PUEDE HACER SIN ESTAR ESPERANDO AL RESTO DEL MUNDO.

The Bolivian branch of the Earth Regeneration Society and the Global Climate Change Group of the Internatinal Society for Systems Science, have supplied to the campaign an outline of what is needed for a carbon dioxide budget. I understand that the city of Cochabamba has decided not only to endorse that campaign, but to actively participate in it. Carlos Aliaga Uria, as the initiator and coordinator of that campaign, and as the current representative of those groups in Bolivia, will be able to assist and advise the City of Cochabamba in calculating the amount of carbon dioxide put into the atmosphere and the amount of carbon dioxide removed from it.

**LA DIVISION BOLIVIANA DE LA SOCIEDAD PARA LA REGENERACION DEL PLANETA TIERRA Y EL GRUPO PARA ESTUDIOS DE CAMBIOS CLIMATICOS GLOBALES DE LA SOCIEDAD INTERNACIONAL DE CIENCIA SISTEMICA, PROPORCIONARON A LA CAMPANA UN LISTADO DE LO QUE SE REQUIERE PARA DESARROOLLAR UN BALANCE DE DIOXIDO DE CARBONO ATMOSFERICO. ENTIENDO QUE LA CIUDAD DE COCHABAMBA NO SOLO APOYARA LA CAMPANA SINO QUE PARTICIPARA EN LA MISMA ACTIVAMENTE. CARLOS ALIAGA URIA, COMO EL INICIADOR Y COORDINADOR DE DICHA CAMPANA, Y COMO EL ACTUAL

REPRESENTANTE EN BOLIVIA DE LAS SOCIEDADES ANTEDICHAS, PODRA ASISTIR Y ASESORAR A LA CIUDAD DE COCHABAMBA EN CALCULAR EL MONTO DE DIOXIDO DE CARBONO EMANADO A LA ATMOSFERA Y EL MONTO REMOVIDO DE LA ATMOSFERA.

This will involve counting the number of automobiles, taxis, trucks, and busses operating in the city; the amount of trees that are cut in the area; measuring the amount of soil erosion and mineral depletion of the soil in Cochabamba. The above will allow the monitoring of how much carbon dioxide is being put into the (or removed the air) in Cochabamba. By moitoring the atmospheric CO/2 and by reducing it as much as possible, we will have, as a civilization, a chance to contribute in regenerating the earth's capacity to sustain life.

**DICHO TRABAJO INVOLUCRA ACCIONES TALES COMO EL CUENTEO DEL NUMERO DE AUTOMOVILES, TAXIS, CAMIONES Y OTROS VEHICULOS OPERANDO EN LA CIUDAD; THE MONTO DE ARBOLES QUE ESTAN SIENDO CORTADOS, LA CANTIDAD DE EROSION DEL SUELO Y LA PERDIDA DE MINERALES. LO ANTERIOR SERA NECESARIO PARA MONITOREAR LA CANTIDAD DE DIOXIDO DE CARBONO QUE SE EMANA Y REMUEVE DE LA ATMOSFERA. MONITOREANDO EL MONTO DE DIOXIDO DE CARBONO EN LA ATMOSFERA Y REDUCIENDO LA MAYOR CANTIDAD DE DICHO GAS, TENDREMOS, COMO CIVILIZACION LA OPORTUNIDAD DE CONTRIBUIR A LA REGENERACION DE LA CAPABILIDAD DE LA TIERRA A MANTENER LA VIDA EN ESTE PLANETA.

Again I thank you for giving to me such high honor; I wish you the very best in participating and strengthening that important campaign started in June of 1989 in your city. I would like to also thank the financial sponsors fo this stage of the campaign which included my visit to Bolivia - the participation of the financal sponsors has been and will be decisive in getting the work done. Finally, I want to thank the campaign itself hoping that my participaton in this stage of it has been positive.

NUEVAMENTE QUIERO AGRADECER AL CONSEJO MUNICIPAL POR HABERME HECHO ESTE HOMENAJE; DE MI PARTE DESEO TODO LO MEJOR EN VUESTRO TRABAJO DE PARTICIPAR Y FORTALECER AQUELLA CAMPANA QUE SE INICIO EN 1989 EN VUESTRA CIUDAD. DESEO TAMBIEN AGRADECER A LOS FINANCIADORES DE ESTA ETAPA DE LA CAMPANA QUE INCLUYO MI VISITA A BOLIVIA -LA PARTICIPACION DE LOS FINANCIADORES HA SIDO Y SERA DECISIVA EN ASEGURARNOS QUE LAS COSAS MARCHEN. FINALMENTE, DESEO AGRADECER A LA CAMPANA MISMA Y DESEO QUE MI PARTICIPACION EN ESTA ETAPA DE AQUELLA HAYA SIDO POSITIVA.

SECTION 7: BIBLIOGRAPHY

BIBLIOGRAPHY: This section is reserved for bibliographies, lists of bibliographies and supplementary bibliographies, followed by an Index.

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SECTION 8: INDEX

INDEX: Combined author and subject index.

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