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About the Institute

The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

UNIVERSITY OF COLORADO

BOULDER, COLORADO 80302

DEPARTMENT OF ECONOMICS

July 8, 1969

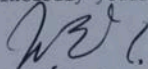
Mr. Gilbert Hersh
Taximetrics Lab
Armory 101
Campus

Dear Gil:

Enclosed find a statement concerning the Seminar in Man-Environment Relationships for next year. I would like for you to be a member of the Seminar which will carry the designation Economics 590 with 6 hours credit for 2 semesters.

Please let me know if you can participate.

Sincerely yours,



Morris E. Garnsey
Prof. of Economics

MEG:ccp

Enclosure

UNIVERSITY OF COLORADO
BOULDER, COLORADO 80302

DEPARTMENT OF ECONOMICS

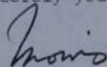
July 10, 1969

Professor David Rogers
Taximetric Lab
Armory 101
Campus

Dear Dave:

I spoke to Ken Boulding about your ideas and he assured me that he is strongly interested in both the mathematical and computer aspects of a Theory of Man-Environment even though his own capabilities lie in other directions.

Sincerely yours,



Morris E. Garnsey
Professor of Economics

MEG:ccp

JUN 6 1969

TO Professor David Rogers

FROM Morris E. Garnsey

SUBJECT

DATE June 3, 1969

UNIVERSITY OF COLORADO

*Interdepartmental
Memorandum*

Dear Dave:

Following our discussion here is a description of the program for next year. I very much hope that your group can participate with the understanding that the Seminar believes that your approach is invaluable.

I also want to invite Gil Hersh to attend the Seminar but I will leave it to you to tell him about it unless you suggest I write him directly. Finally, I remind you that we are planning to invite Mr. Walter Jessel from Political Science and a computer expert employed at IBM.

5 June 1969

Dr. Morris Garnsey
Department of Economics
University of Colorado

Dear Morris:

I (in concert with members of this team) have been thinking rather intensively about your invitation to join the upcoming seminar. As I promised, I'm now trying to write down some of my ideas about the seminar and how I (and we) might best participate in it.

Let me tell you first that I am very enthusiastic about the ideas you proposed for the seminar. The type of work, where most of the thoughts and information are qualitative, are (or possibly are) very close to the types of concepts and things we have had to work with in taxometrics. Most of the working ideas are held intuitively by the knowledgeable person, and there has not been a chance to speak of these ideas in terms of a mathematical model. This does not indicate that the ideas are not powerful, but rather that to work with these ideas, for some pragmatic effort or for someone to actually employ the ideas, is very difficult.

To generate some theory of man-environment relationships is excellent and I concur in the need for such, but we (in taxometrics) always ^{try to} go further, to discover the thinking rules by which one gets to the theory. If we can discover these rules, then it is more likely that some mathematics may be applied which will tell us whether we have the necessary and sufficient conditions to meet the objectives which also need careful statement. If, further, we can reword the rules mathematically, we are in a better position to generate practical algorithms and computer programs to aid us in manipulating data gathered for meeting some precise objectives.

It is with respect to these ideas that I asked you during our lunch whether Ken Boulding was willing to join in the rather difficult task imposed by the above. We would not want him to think us nosy, pushy, naive, rude, or any other undesirable descriptive adjective, just because we want to get down inside his thinking apparatus to work out the rules. We have had experience in the past where some knowledgeable individual was offended when we asked "How do you know this?" when all we really wanted was some statement which told us how, in context of his own discipline, he could get to some positive statement. If Dr. Boulding finds such an exploration objectionable, then we would not want to subject him to our exploratory methods, nor to take up time which we could put to work somewhere else.

We also have a desire in this shop for some practical output from the theoretical work. We always try to go from the theoretical to the practical, albeit not 100% successfully. But because of our bent in this direction, I wonder how you (and others in the seminar) would react to an idea that we want to do an actual investigation on regional economic study which we have already been discussing in this lab. We thought that the seminar members could act as a sort of advisory, consultative, idea-producing group as we go about the design of a regional study, and then, with some actual data, we could give a test of the theoretical output from the seminar. Just how we would interact with members of the seminar in this type of effort is not known to us, but we hope that somehow such an effort can be meaningful for all concerned.

I hope you can talk these ideas over with Ken Boulding, and any others whom you consider to be involved, and if you like, we can all sit down informally to get our ideas out into more meaningful form. However, I hope you will take this memo as confidential between you and me. I hope you can translate some of these ideas in your own language to Dr. Boulding, but I feel certain that we would not be well understood if he read this paper.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

May 26, 1969

TO: MEMBERS OF THE SEMINAR

FROM: MORRIS E. GARNSEY, DIRECTOR, PROGRAM IN MAN-ENVIRONMENT RELATIONSHIPS

In our announcement for the Seminar meeting of May 14 we called your attention to the unusual opportunity to discuss "Designs and Decisions for Environmental Quality, An Environmental Engineer's View of Here and There and the Odds on Getting Anywhere" which was presented as a paper by Dr. Thomas W. Bilhorn of NCAR and discussed by members of a panel.

The meeting turned out to be most productive and those who were present profited from it. Consequently, we have decided to distribute to all members of the Seminar a copy of Dr. Bilhorn's paper which is enclosed. (The panel and audience discussion was not recorded).

An announcement of the plan for the Man-Environment Program for 1969-70 will be distributed to members of the Seminar. The Seminar as presently constituted will not meet during the next academic year.

Those of us who organized the Seminar are very grateful to the faculties of CU, DU and CSU, graduate students and staff members of ESSA and NCAR who have shown an interest in this area of vital concern and who have attended the Seminar during the last two years.

P.S. At the last meeting of the Seminar Professor Udis commented upon some ideas from a book and was asked to forward to the members of the Seminar a bibliographical reference to the volume. It is as follows:

Richard S. Rosenbloom and Robin Morris (eds.), Social Innovation in the City: New Enterprises for Community Development, A Collection of Working Papers. (Cambridge, Harvard University Program on Technology and Society, 1969). Distributed by Harvard University Press at \$3.00.

DESIGNS AND DECISIONS FOR ENVIRONMENTAL QUALITY

An Environmental Engineer's View of Here and There and The Odds On Getting Anywhere

T. W. Bilhorn,

An "environmental Engineer" uses his title as a convenience; it represents a variety of fields rather than one specific discipline. His interests are in the wise development of natural resources, and as a professional he wishes to contribute his efforts to the improvement of the quality of our environment.

But will he have time? Does the unrest and pressure of population give us time to rebuild our cities; redesign our water utilization systems, our agriculture, our use of environmental resources, our social structures? Secondly, do we have the necessary design talents? Can we see broadly enough to find better ways? Can we handle the increasing complexity of our present and future problems?

An incident of some years ago comes to mind to emphasize these concerns. In the days of early stratospheric exploration, at the time of the National Geographic Explorer manned balloon flight, another country conducted a similar flight. The designers, realizing the need for protection against the low pressure of the stratosphere, built a heavy spherical gondola with a strong hatch which fastened securely with heavy bolts. Failure of the balloon was also possible, so the two observers carried parachutes. During the flight the balloon did in fact fail. The story goes that the two men ran out of escape time -- by one bolt. The terror of those minutes is even more grim when it is realized that since the higher pressure was on the inside, placing the door inside with no fasteners, but a small air valve, would have allowed escape in seconds. Narrow vision in the form of "build-it-strong-use-heavy-bolts" engineering unnecessarily created the tragedy.

Even if one did not feel that there are urgent environmental problems requiring design capabilities, we must improve the capabilities we have in their own right. A successful engineer does two things well. He is able to see problems clearly; he is a good diagnostician. Secondly, he is able to acquire a large body of knowledge from which he assembles a solution. There is a great deal of writing and talking about the second area. For example, a recent article said that because of the accumulation of new knowledge an engineer is obsolete in his field seven years after graduation! If he has become "obsolete" or rather, incapable of solving the problems presented him, it is because he either no longer can see them clearly or has lost the capability of searching for relevant information.

Our present manner of solving problems has four critical characteristics. Some need changing, others must be taken carefully into account in developing better methods of design.

- 1) Cart-Before-the-Horse Technology. The devices and systems we have produced are frequently solutions looking for a problem, solutions which come from very personal individual motivation and the proprietary interests of organizations both private and public. Examples are satellites, infrared sensors, and digital computers; capabilities and products developed for an initial need, but which continue searching for a problem to solve. We have a large industrial-scientific capacity to produce knowledge and things. By its nature this capacity is not very flexible and cannot be turned off and on. We would not want to turn it off and on even if we could; we don't want the economic and social upheaval and we don't want the loss of creative abilities. Rather we must have a complementary capacity to understand our problems and fit our capabilities to our needs.
- 2) Breakthrough Philosophy. Too commonly we expect a technological fix. We have a ferish about black boxes. We have made a great effort to produce DDT and are now doing the same on auto smog accessories. I believe non-technological adjustments may frequently be better. For example, airports should be moved and the area zoned, rather than expending great efforts on trivially successful noise abatement devices and hazardous take-off procedures.
- 3) Tunnel Vision. Groups capable of action are often too tightly constrained in their breadth of possible designs. In industry there are the constraints of short-term profit and limited scope of services and products. In government and universities there are similar limitations established by departments and disciplines. "Systems" groups exist but disappointingly, with depth mainly in mathematics but not in the other talents necessary to develop accurate analogs.
- 4) One Man, "Blue Ribbon" Experts. It is a continuing, popular concept that expertise and success in one area make an expert in all areas, e.g. a nuclear physicist advising on the population explosion. More critically this notion produces small "blue ribbon" committees preparing crucial plans in three meetings, based upon notes read hurriedly on the plane; committees of busy, good-intentioned specialists who hardly have time to learn each other's language much less attack their work cohesively; committees, based upon past experience, which shrink in variety of talents rather than grow in time to become an effective organization.

Hopefully these are convincing arguments for the development of multi-disciplinary design groups. They are needed because environmental problems are complex and beyond the capability of an individual or a single discipline. They are needed because the solution is not a single device or procedure, but composed of bits and pieces from many technologies and disciplines.

Agreed that successfully solving environmental problems requires a team effort, who are the players? We could start by saying "Well, several physical scientists, their knowledge is basic to understanding the environment; an economist, somebody is going to have to pay for implementing our solution, he can figure out how much, and he can talk the language of cost/effectiveness." Some really perceptive soul might also point out that an economist is good at comparing apples to oranges and environmental problems might have some of that in them. A lawyer? Maybe an engineer to figure out manufacturing and construction problems? Of course, a really up-to-date group would include an ecologist. Anybody know an ecologist who doesn't just want to conserve everything? (That, unfortunately, is an all too common view of the technologist regarding many of the social sciences.)

Once around such a mulberry bush it's no wonder the committee members want no further part of the problem and those left with the responsibility turn to one-man efforts. His solution may not be exceptional, but one man is far easier to talk with than a committee. It is increasingly apparent that we need to break through not in technology, but in organization.

Why don't we start with an organization based on the work of those who have studied the process of decision making, and incorporate some of the techniques of groups like Resource for the Future (RFF), the Harvard Water Study Program, MIT, and Stanford. In defining the tasks the organization must face, the management scientist concludes that problem-solving involves effort in the following areas.

- 1) Determining the Decision-Making Authority. Who has this power? Does it in fact exist? Pollution problems, almost by definition, extend beyond a single power structure. The group may find that most of its efforts will be in the design of an authority. In a very practical and personal sense our experience teaches us that to see our designs implemented we must know the decision maker well, recognizing his viewpoint and constraints. Lawyers and political scientists perhaps have the greatest knowledge in this area of public power structure, and could make a substantial contribution to our group.

- 2) Determining the Objective. Objectives in air pollution or mass transportation are very hard to pin down. Automobiles certainly fulfill needs other than the economical transportation of people and goods. But are not also critically important the factors of escape, personal freedom, excitement, and satisfaction of status? Air pollution combines elements of health, visibility, deterioration of materials, and injury to plant life. Somehow an objective function describing the problem must be constructed, perhaps similar to that conceived by the Harvard Water Program for the value of differing river flow rates and that of RFF for estuarine pollution. The critical contaminants must be identified and their uncontrolled concentration plotted against a "design year" (a statistical grouping developed from climatological extremes and population projections). Desired concentration levels and durations then must be derived. Accomplishing the definition of objectives will require many talents; medical specialists, materials and atmospheric chemists, meteorologists, sociologists, geographers, economists, and ecologists would play vital roles.
- 3) Development of Alternatives. We are all at home with this effort and rather easily accept the searching and building of a possible solution. It is important to realize, however, that the success and efficiency of this task's solution is very much dependent upon completion of the two just stated. If we are given a concise statement of the objectives and have a clear, accurate analog of the system, effective alternatives will come. Especially notable is an approach used by RFF in pollution work. In their development of alternatives they have not selected just one for presentation. They have realized that environmental quality objectives are quantitative; that is, a quality level is a percentage kind of thing rather than "go-no go." Groups will be more responsive to presentation of several alternatives with statements of the quality level they can achieve and their cost. A list of contributors to the development of alternatives is hard to limit. Physical scientists and technological specialists, city planners, economists are perhaps the critical talents.
- 4) Construction of a Criteria of Best Solution. The yardstick used to select among alternatives is rarely so simple as cost. It involves questions of personal freedom, complexity, and the distribution of costs and benefits. Sociologists, lawyers, economists, government representatives perhaps can make the most headway in defining success criteria.

Many groups of this description are needed. They may be commercial enterprises; parts of federal, state, and local governments; or university operated. Their outputs, of course, are successfully implemented designs. Because a definitive organizational method is difficult to

visualize, the flexibility of a university effort is particularly appropriate. Fringe benefits are possible in a university group; training of individuals to work in such a group is important, for both students and faculty! A university environment is also excellent for study of the group's action and the development of new organizational methods.

A university group can also perform a function perhaps equally as important as problem solving, the analysis of impact. Scientists and technological administrators constantly face the question of the implication of their new knowledge. Is it useful, where can it best be applied, what problems will it create? If the group described can perform well in environmental problem solving, it could equally well perform this role of providing foresight.

* * * * *

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

MAY 6 1969

MAY 8 1969

TO: MEMBERS OF THE SEMINAR
FROM: Morris E. Garnsey

The final meeting of our Seminar is sure to be most interesting, and promises to give us a lead toward significant activities of the Seminar in 1969-1970.

SUBJECT: DESIGNS AND DECISION FOR QUALITY: ENGINEERING SYSTEMS ANALYSIS.

(A sub title might be "How to Identify a Practical Problem and Design an Effective Solution").

The topic will be discussed by a panel whose leader will be:

Dr. Thomas Bilhorn of NCAR

He will be ably seconded by

Dr. Thomas Flynn of ESSA

as well as by

Dr. Curtis Johnson, Chairman Chemical Engineering

Dr. Robert Ayre, Chairman Civil Engineering

Dr. Eugene Haas, Professor of Sociology

The Seminar will meet on Wednesday, May 14 from 3:10 to 5:00 PM
in UMC Rm. 157B (Please note change of room).

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

March 3, 1969

TO: Members of the Seminar
FROM: Morris E. Garnsey, Chairman

Please plan to attend the next meeting of the Seminar which will be held on Wednesday, March 12 at 3:10 p.m. in the University Memorial Center, room 158.

Our speakers will be:

Dr. Roger S. Mitchell, Director, Webb-Waring Institute for Medical Research, University of Colorado Medical Center - Medical and Health Aspects of Air Pollution.

Professor Gary Widman, University of Denver Law School - Legal Aspects of Air Pollution.

Professor Jay Crowe, Sociology Department, University of Colorado, Denver Center - Social Aspects of Air Pollution.

This will be a full and interesting program.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

February 18, 1969

TO: Members of the Seminar
FROM: Morris E. Garnsey, Chairman

The attached article was discussed at the last meeting of the Seminar.

FEB 21 1968

THE NEW YORKER

April 13, 1968

DISTRIBUTED BY
COLORADO
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL SECTION

THE AMBIENT AIR

by Edith Iglauer

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

February 4, 1969

TO: Members of the Seminar
FROM: Morris E. Garnsey, Chairman

As announced at the beginning of the academic year, the Seminar will concentrate in the Spring Semester on Air Pollution, with Special Reference to the Denver Airshed.

The following programs have been scheduled:

Wednesday, February 12, University Memorial Center, room 158,
3:10 to 5:00 p.m.

Mr. Loren Crow, Consulting Meteorologist, Denver -
Meteorology

Professor Paul Urone, Chemistry Department, University of
Colorado - Chemistry

Wednesday, March 12, University Memorial Center, room 158,
3:10 to 5:00 p.m.

Dr. Roger S. Mitchell, Director, Webb-Waring Institute
for Medical Research, University of Colorado Medical
Center - Medical and Health Aspects of Air Pollution

Professor Gary Widman, University of Denver Law School -
Legal Aspects

Professor Jay Crowe, Sociology Department, University of
Colorado-Denver Center - Social Aspects.

Wednesday, April 9, University Memorial Center, room 158,
3:10 to 5:00 p.m.

Mr. Fred Longenberger, Air Pollution Control Engineer, City
and County of Denver - Problems of Administration and
Enforcement.

Dr. Edward W. Walbridge, Department of Astro-Geophysics,
University of Colorado - Minimal Air Pollution City.

As a result of numerous suggestions, graduate students have been invited to participate in the Seminars during the Spring Semester. The following have been invited:

- Richard Berger - Astro-Geophysics
- Ralph Brown - Economics
- Dr. Wayne Christiansen - JILA
- Gary Fick - Physics
- Gerald Godden - Physics
- Dr. R.D. Hudson - JILA
- John Jacobs - Geography
- Verne Loose - Economics
- Evan Meltzer - Chemistry
- Tapan Mukerjee - Economics
- David Pheasant - Arctic and Alpine Research
- Bill Reid - Biology
- Robert Temple - Electrical Engineering

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

December 16, 1968

RESOURCES FOR FUTURE TO SHIFT EMPHASIS

Washington - Resources For the Future will turn more of its research talents towards air pollution, solid waste and noise during the next years, as the nonprofit resource research group takes a closer look at environmental quality.

President Joseph L. Fisher explained last week that RFF is shifting to resource quality and away from its earlier major push, which was the quantity of natural resources available. This included emphasis on the long range outlook on demand for resources such as agriculture, land, and forest products. But now, says Fisher, the push should be not only on quality but also on the types of institutions that should be set up to deal with environmental problems.

Fisher's remarks came as he announced an \$8 million grant from the Ford Foundation to support RFF programs for five years beginning next October. Ford, which provides virtually all RFF funds, has now given \$26 million in basic support money to the organization in four five-year grants. RFF spends the money through grants to universities, and through in-house work.

Most of the research is done in the social sciences and of the environmental field. And along this line, Fisher said RFF will take a look at "the behavioral responses to resources and environmental studies." Or, as he puts it "why do Americans mess the place up the way we do." So he envisions a series of grants in social physiology and behavioral sciences.

Air & Water News, Vol. 2, No. 50, December 9, 1968, McGraw Hill

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

TO: MEMBERS OF THE SEMINAR
FROM: MORRIS E. GARNSEY, CHAIRMAN

December 3, 1968

The following is from the New York Times Book Review, November 17, 1968

The Wreck of a Tanker - OIL AND WATER, The Torrey Canyon Disaster by Edward Cowan, J. B. Lippincott Company

by Edward B. Garside

On March 18, 1967, the 974-foot supertanker Torrey Canyon, traveling at nearly full speed, rode onto Pollard Rock, a granite reef in the Scilly Islands 16 miles off the southern tip of England. At once, vast quantities of oil, from her cargo of over 35-million gallons, began to hemorrhage from the wound in her bottom. Mile-long pools of the sticky black pollutant, a foot or more in depth were impelled by the boisterous winds of the season onto the Cornish coast. In time, the evil stain spread across the Channel to the shores of Brittany, threatening to ruin resort beaches and to destroy the micro-organic ecology of the shallows on which the sea's life-cycle depends.

Every aspect of this typically modern, man-made catastrophe has been reconstructed here by New York Times reporter Edward Cowan. The British Government, Mr. Cowan tells us, was forced to improvise every countermove, since an emergency of this kind had never been experienced before on such massive scale. Barriers made of linked plastic floats failed to work. Detergents to emulsify the oil, applied by civilian volunteers and servicemen, proved only minimally effective.

Placing responsibility for damages became a burning issue. The accident had occurred just outside territorial waters; the American owners, using a Dutch salvage service, had to be given every chance to retrieve their \$27-million vessel in whole or part before she was finally sunk by bombing.

Private interest was clearly at great odds with public interest, with no body of law to decide the matter. This in turn focused public attention on the mysterious and lucrative business of oil transport - and, ultimately, on the relative immunity from regulation of oil companies throughout the world. All these subjects Mr. Cowan explores in close detail and with suspenseful effect.

A perfunctory investigation was carried out in Genoa, since it was there that the Torrey Canyon's officers and crew had been engaged through the Fratelli Cosulich, or firm of Cosulich Brothers. A British representative attended the hearings, but only over American protest and with the proviso he could ask no questions. Blame was placed on Capt. Pastrengo Rugiati, but to this day no one really knows just why he took the hazardous course he did, or steered onto a well-known reef in broad daylight on a clear day.

The Torrey Canyon, it developed, was owned by Barracuda Tanker Corporation, a creation of Dillon Read & Co., Inc., using funds provided by Manufacturers Trust. Original stockholders put up only \$20,000 and were to have realized a \$1 million profit in 20 years, subject only to capital-gains tax. Barracuda's official address was Hamilton, Bermuda. The tanker was registered in Liberia

(again to escape taxes). And at the time of the accident the Torrey Canyon was on sub-charter to British Petroleum, carrying crude from Kuwait to Milford Haven in Wales, according to an arrangement approved by the vessel's formal patron, Union Oil of California.

All this made for complication and so clouded the responsibility issue that no damage claim has been adjudicated to this day and probably never will be. Instead, the question of oil pollution has been swept under the rug by assigning it to obscure United Nations study.

Mr. Cowan, in fact, suggests that the oil industry (if the reactions of Union Oil, Barracuda and British Petroleum are any criterion) at the best may be expected to temporize, at the worst to resist tooth-and-nail should any permanent accommodation be sought on who is to pay for mopping up when a big tanker wreck occurs. In England alone, it cost \$8-million plus to scrub up after the Torrey Canyon. Meanwhile, 500,000-ton tankers are on the drawing board, capable of far greater damage in a similar break up. On the evidence in this book, one is forced to the conclusion that international oil will be only reluctantly persuaded to let this growing risk cloud the profit picture.

It is hard to say which is more fascinating, Mr. Cowan's evocation of the Torrey Canyon disaster as a physical experience, or his dissection of the hidden workings of the oil corporations. In any case, his reconstruction is highly readable. Beyond this, it is informative to such degree that it no doubt will serve as a source of reference and guideline, when the great powers bestir themselves to contain the ever-present dangers posed by the modern supertanker.

TO Dave Rogers

FROM Morris Garnsey

SUBJECT _____

DATE November 4, 1968

UNIVERSITY OF COLORADO

*Interdepartmental
Memorandum*

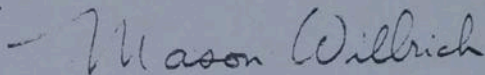
I was more surprised than you by Bob Low's attitude at lunch the other day since I have known him for quite a long time.

I am sending you a copy of a prospectus for an environmental studies group at the University of Virginia. You will notice how strong is the emphasis upon an interdisciplinary approach.

CENTER FOR THE STUDY OF SCIENCE,
TECHNOLOGY AND PUBLIC POLICY
UNIVERSITY OF VIRGINIA
CHARLOTTESVILLE, VIRGINIA 22901

The University of Virginia established on July 1, 1968, a new Center for the Study of Science, Technology and Public Policy. The Center is receiving initial support from the National Science Foundation as part of the Foundation's planning and policy studies program. The major function of the Center is to initiate and support interdisciplinary studies of problems with scientific or technological underpinnings which raise important issues of public policy.

Attached is a brief statement of the orientation and organization of the Center and plans for program development. I will be pleased to receive comments and suggestions, and to answer specific inquiries.



Mason Willrich

Director and Professor of Law

Enclosure

ORIENTATION

The Center's programs and activities will be primarily problem oriented. The Center will initiate and support the study of specific problems and clusters of problems confronting society in which scientific or technological factors are major considerations.

Criteria for selection of problems for study will be:

- importance to our national society and the world community of developing a public policy adequate to deal with the problem;
- importance of science or technology as a component of the problem;
- inadequacy of the existing public policy framework and policy processes for effectively dealing with the problem in the future.

Problems of particular relevance to communities at the local, state and regional levels will also be appropriate for study.

The entire set of problems which constitutes the field of science, technology and public policy is too broad to be studied in depth within any single academic enterprise. Therefore, the nature and limits of the Center's programs will depend to a large extent on the particular interests of the University of Virginia faculty and students as these interests are developed.

APPROACH

An interdisciplinary approach will be applied in all phases of the Center's activities, including the selection and definition of problems for study, problem analysis and the development and evaluation of policy alternatives. Law,

political science and economics, because of their central concerns with public policy, will probably be involved in most sponsored activities. The extent of involvement of the other social sciences, the natural and life sciences and other professions such as engineering, medicine, architecture and business administration will depend on the nature of the problem.

Moreover, an effort will be made to involve both policy makers and those affected by policy in the study of problems bearing on their interests. The University of Virginia's close proximity to Washington gives it distinct advantages in developing activities of mutual concern to the Federal Government and the academic community. The Center's activities will also draw upon state and local government, as appropriate, and could involve interested faculty in other institutions.

OBJECTIVES

The objectives of the Center are:

- to increase understanding of the interactions between scientific-technological processes and political, economic, legal and other social processes;
- to provide an academic input to the policy planning process in areas where science, technology and public policy intersect.

Apart from the basic characteristics of problem orientation, interdisciplinary approach, and policy planning objectives, the Center will not attempt to follow any uniform or preconceived methodology. The institutions of policy formation and implementation in a particular problem area will be studied, as well as the content of the policies and the choice of preferred alternatives. However, the methodology will be tailored to the problem under study and will be derived in each case largely from contextual analysis.

ORGANIZATION

The Center is based in the School of Law, but has University-wide dimensions. The Director of the Center has primary responsibility for development and direction of the Center's activities and administration of support for these activities.

Two committees will be established in conjunction with the Center. The Administrative Committee, drawn primarily from the University administration, will ensure that the Center's general program has continuity and is consistent with the over-all plans of the University for long-range development. This Committee will also provide assurance to the faculty of the administration's backing of the Center as an integral part of the University.

The Program Advisory Committee will be composed of faculty members drawn from the various Schools and Departments of the University having an interest in the Center's program and will serve a dual purpose. It will provide the Director with advice concerning content of the Center's programs and proposals for projects for Center support. It will also provide a mechanism for generating broad interest in the Center throughout the University.

PROGRAM DEVELOPMENT

The development of program concepts and new areas of interest will be a continuing function on which the success of the Center will ultimately depend. Although it would be premature to indicate specific content, it may be helpful to set forth a range of possibilities, some of which are obviously long-term, for program development which might be considered by the Center:

- a. Specific projects organized and directed by one or two faculty members using graduate students and possibly outside consultants as appropriate;

- b. Selected problem seminars for Federal, state and local government officials, representatives of those parts of society primarily affected, and members of the academic community for intensive investigation by experts over a one or two-week period of a problem of mutual concern;
- c. "Sabbatical" programs in the Center for government officials whose major career concern is in dealing with the public policy aspects of science and technology;
- d. Interdisciplinary group research seminars.

The following illustrates how a policy study might be conducted using a group research seminar as a framework. Such a seminar approach would be intended to provide the vehicle for intensive participation by the relevant academic disciplines, on both faculty and student levels, and also interaction among the academic community, government policy makers, and those directly affected by policy.

The first step might be to convene a one-week extra-University seminar, including key University faculty and expert participants from the government, academic and social communities outside the University of Virginia. The purpose of this seminar would be to articulate the precise nature of the problem, its scientific and technological underpinnings, and the general policy issues raised by it. The next step could be the convening of an intra-University research seminar, drawing on outside expertise as needed. This seminar could extend over a semester or an academic year. Participants would include a balance of University faculty and graduate students from the relevant disciplines. Participation by faculty members would constitute part of their respective work loads for the period involved. Student participants would receive academic credit, and research and writing undertaken in the seminar would be relevant to graduate degree research. Following conclusion of the intra-University seminar, the extra-University seminar could be reconvened, or reconstituted, to review and evaluate the results.

The following is a list of projects which will be supported by the Center during the first year, support extending in some cases beyond one year.

1. Nuclear Energy and World Order.

Faculty researcher - Mason Willrich
Professor of Law and
Director of the Center

A study of the international dimensions of the scientific-technological process as it relates to nuclear energy to determine the amenability of the process at its various stages (research, development and application) to policy regulation and control.

2. The Organization of Research: A Comparative Study.

Faculty researcher - John H. Moore
Assistant Professor of
Economics

A comparative study of policies and organizations for research and development in selected countries in order to provide an insight into the effectiveness of alternative institutional arrangements and a basis for national science policy recommendations.

3. Population, Technology and the City.

Faculty researcher - Thomas F. Bergin
Professor of Law

A study of city problems likely to be generated by future population increases, and the ways in which scientific and technological developments can be utilized with maximum beneficial effects in dealing with these problems.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

PARTICIPANTS

1968-1969 (Revised)

Professor Robert Ayre, Civil Engineering
Dr. George Benton, Director, Institutes for Environmental Research, ESSA
Dr. Thomas Bilhorn, Head, Program on Applications Analysis, NCAR
Professor Kenneth Boulding, Economics
Dr. Richard Cadle, Head, Chemistry & Microphysics Dept., NCAR
Professor Donald Carmichael, Law
Dr. John Cobb, Preventive Medicine
Professor James Corbridge, Law
Mr. Loren Crow, Consulting Meteorologist, Denver
Mr. Robert Davis, Office of Planning, ESSA
Professor Morris E. Garnsey, Economics
Professor Eugene Haas, Sociology
Professor John Ives, Arctic and Alpine Research
Professor Curtis Johnson, Chemical Engineering
Dr. Archie Kahan, Chief, Office of Atmospheric Water Resources, Bureau
of Reclamation
Dr. William Kellogg, Director, Laboratory of Atmospheric Science, NCAR
Dr. Dwight Kline, Deputy Director, Office of Programs Rx3, ESSA
Mr. Robert Knecht, Deputy Director, IER, ESSA
Dr. John Kralewski, Preventive Medicine
Professor Frank Kreith, Chemical Engineering
Dr. Joachim Kuettner, Director, Office of Advanced Research Projects, ESSA
Professor Gottfried Lang, Anthropology
Dr. Gordon Little, Director, Wave Propagation Laboratory, ESSA
Dr. James Lodge, NCAR
Mr. George Lof, Consulting Chemical Engineer
Mr. Fred Longenberger, Air Pollution Control Engineer, City and County
of Denver
Professor Askeel Love, Biology
Professor John Marr, Arctic and Alpine Research
Dr. R. Michael McClintock, Physics and Astrophysics
Professor Phillip Ostwald, Engineering Design and Economic Evaluation
Professor Horace Quick, Geography
Mr. Roger Rhodes, Assistant Director, Wave Propagation Lab. ESSA
Dr. John Rinehart, Director of University Relations, ESSA
Professor David Rogers, Biology
Mr. Lewis Rose, Telecommunications Sciences, ESSA
Professor R. D. Sloan, Political Science
Mr. Frank Smith, Program Planning Officer, ESSA
Dr. Perri Stinson, Denver Research Institute
Dr. J. Robert Stinson, Associate Chief, Office of Atmospheric Water
Resources, Bureau of Reclamation
Dr. Daniel Teitelbaum, Medical School
Dr. Philip Thompson, Associate Director, NCAR
Professor Bernard Udis, Economics, Director, Bureau of Economic Research
Professor Stanislaw Ulam, Mathematics
Professor Paul Urone, Chemistry
Professor Steven Vandenberg, Psychology
Dr. Helmut Weickmann, Director, Atmospheric and Chemistry Lab. ESSA
Dr. Bettie Willard, Thorne Ecological Foundation
Dr. Edwin Wolff, Administrative Officer, NCAR
Professor Frank Barnes, Electrical Engineering

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

PARTICIPANTS

- EC OT 4-34 Professor Robert Ayre, Civil Engineering (Chairman) ✓
 1420-30 St. Dr. George Benton, Director, Institutes for Environmental Research, ESSA ✓
 Dr. Thomas Bilhorn, Head, Program on Applications Analysis, NCAR ✓
 IBS #3 208 Professor Kenneth Boulding Economics ✓
 Law 228 Professor James Corbridge, School of Law ✓
 EC CE 4 Professor Ernest Flack, Civil Engineering ✓
 HA 239 Professor Morris Garnsey, Economics ✓
 IBS #5 Professor Eugene Haas, Visiting Professor of Sociology ✓
 Ketchum 123 ~~Professor Kenneth Hammond, Psychology~~
 X ~~Dr. James Hibbs, ESSA, Office of Planning and Program Evaluation**~~
 EC OT 206 Professor Curtis Johnson, Chemical Engineering (Chairman) ✓
 Dr. William Kellogg, Director, Laboratory of Atmospheric Science, NCAR ✓
 Hellesms 6E Professor A. J. Kelso, Anthropology (Chairman) ✓
 1420 30 St. Mr. Robert Knecht, ~~Director, Space Disturbances Laboratory~~, ESSA, Deputy Director ✓
 IBS #2 200 Professor Gottfried Lang, Anthropology ✓
 1420 30 St. Dr. Gordon Little, Director, ~~Institute for Telecommunication Sciences~~
~~and Aeronomy~~, ESSA, Wave Propagation Laboratory ✓
 Mr. George Lof, Consulting Chemical Engineer, 817 Farmers Union Bldg., Denver 80302 ✓
 Armory X Professor John Marr, Institute for Arctic and Alpine Research ✓
 325 B'way Mr. Roger Rhodes, ESSA ✓
 1420 30 St. Dr. John Rinehart, Director of University Relations, ESSA ✓
 Hale X Professor David Rogers, Biology
 Hellesms 205 Professor R. D. Sloan, Political Science, Asst. Dir. Bureau of Governmental
 Research ✓
 1420 30 St. Mr. Frank Smith, Program Planning Officer, IER, ESSA ✓
 Dr. Philip Thompson, Associate Director, NCAR ✓
 HA 237 Professor Bernard Udis, Economics, Director, Bureau of Economic Research ✓
 EC OT 4-43 Professor Stanislaw Ulam, Mathematics ✓
 Ketchum 126 ~~Professor Steven Vandenbergh, Psychology~~
 X Dr. Bettie Willard, Arctic and Alpine Research-Thorne Ecological Foundation,
 1229 University, Boulder ✓
 Armory X Dr. John Ives, Director, Arctic and Alpine Research ✓
 1420 30 St. Dr. J. P. Kuettnner, Director, Advanced Research Project, ESSA

26
 + 10
 NCAR address -- 1850 Table Mesa Drive, Boulder

** Dr. Hibbs -- Office of Planning and Program Evaluation
 ESSA
 Washington Science Center -- Bldg. 5
 Rockville, Maryland 20852

REPORT ON
MAN-ENVIRONMENT RELATIONSHIPS FOR 1967-68
TOGETHER WITH
PROPOSED PROGRAM FOR 1968-69

by

Morris E. Garnsey

Director, Program in
Man-Environment Relationships

University of Colorado
Boulder, Colorado
May 27, 1968

INTRODUCTION

The current academic year is the first full year of activity in the Man-Environment Relationships Program. The Conference held in 1966-67 represented the beginning of organized interest in this area. The program itself was authorized by Dean Manning in December, 1967. However, the Faculty Research Seminar was organized in the fall of 1967 and research proposals were drafted.

FACULTY RESEARCH SEMINAR

The Faculty Research Seminar met monthly during the academic year, according to the following schedule:

October 11, 1967 - "The Spaceship Earth - Remarks on the Ecosystem,"
Kenneth Boulding.

November 8, 1967 - "Physical Science and the Environment," Dr. Willard
Libby.

December 13, 1967 - "Problems in Sociological Research on Natural Disasters
and Weather Modification," Dr. Eugene Haas.

Note: In December all members of the Seminar were requested to submit research topics in order to find out which areas of research were of interest to two or more persons, as a way to explore the possibilities of cooperative research efforts among two or more professions. A questionnaire was circulated with a list of topics (see attached) and as a result, two task forces were set up at the January 17 meeting. These were: Task Force on Education in Environmental Problems; and Task Force on Priorities for Public Investment - Methodology for Valuing the Natural Environment.

January 17, 1968 - Discussion of the results of the questionnaire.

February 21, 1968 - "Some Economic Problems in Air Pollution Control,"
Dr. Paul Gearhart, Director, Social Sciences Division, National Center for Atmospheric Pollution Control.

March 13, 1968 - Dr. Curtis Johnson reported briefly on the Task Force on Education describing the Seminar in Environmental Problems which he and Dr. Ayre are conducting in the School of Engineering, which is intended to acquaint engineering students with some aspects of the social and environmental implications of engineering projects.

Mr. Robert Knecht presented a schematic outline under the two major headings - the effect of environment on man and his activities and the complimentary reverse, the effect of man's activities, adverse or beneficial, on the environment.

Mr. Frank Smith suggested that a final and definitive selection of topics for discussion in the Seminar could not be made until the members had described the approach to environmental problems of each particular discipline.

April 10, 1968 - Mr. Frank Smith's suggestion of March 13 having been adopted, views on man-environment relationships from different disciplines were presented as follows:

James Corbridge, Law
Curtis Johnson, Engineering
John Marr, Ecology
David Rogers, Biology
R.D. Sloan, Political Science
Bernard Udis, Economics

May 8, 1968 - "The University of Wisconsin-Green Bay Philosophy and Undergraduate Program in Man-Environment Relationships," Chancellor Edward W. Weidner.

A report on the activities of the Seminar in the form of a journal article is being prepared by Dr. James R. Hibbs and Mr. Frank Smith of ESSA, for publication in a scientific journal.

A list of participants in the Seminar is attached.

Materials Prepared for the Seminar

Announcement of the Seminar, September 1, 1967.

"Environmental Quality Control: A Statement of the Problem,"
Douglas L. Brooks.

Questionnaire - Expression of Interest in Selected Areas of Man-Environment Research.

Questionnaire - Summary of Replies.

Statements by Messrs. Robert Knecht and Frank Smith regarding:
Setting Priorities for Public Investment in Man-Environment Relationships, and Developing Methodology for Valuing the Natural Environment.

Preliminary Draft Proposal for a Planning Conference Directed Toward Organization in Colorado of a Consortium for Research and Education in Man-Environment Relationships, to the Ford Foundation.

Controlling Pollution, The Economics of a Cleaner America,
Marshall I. Goldman, ed., Prentice Hall.

"Can the World Be Saved," by LaMont C. Cole, reprinted from the New York Times Magazine, March 31, 1968.

Extract from: The University of Wisconsin-Green Bay Statement of Philosophy and Undergraduate Program, January 5, 1968.

Minutes of Meeting of the Seminar on Man-Environment Relations, April 10, 1968 - Poem by Kenneth Boulding.

Social Sciences and the Environment, Morris E. Garnsey and James R. Hibbs, eds., The University of Colorado Press, Boulder, Colo., 1968, pp. VI-249.

RESEARCH ACTIVITY

In December, Dr. Eugene Haas received a grant from the National Science Foundation of \$172,286 for the first two years of a three-year study of Selected Social Consequences of Planned Weather Modification. A second proposal in the amount of \$395,061 for "A Preliminary Study of Selected Social, Economic and Engineering Aspects of Tsunami Hazard: A Study in Earthquake Engineering" is pending with the National Science Foundation. This proposal was prepared and submitted jointly by Eugene Haas, Robert Ayre and Morris Garnsey.

BOOK PUBLISHED

In April the University of Colorado Press published Social Sciences and the Environment, edited by Morris E. Garnsey and James R. Hibbs. This volume contains the papers presented, and discussions held, at the Conference on the "Present and Potential Contribution of the Social Sciences to Research and Policy Formulation in the Quality of the Physical Environment," January 31, February 1 and 2, 1967. This Conference and the "Papers" were supported by a grant from the Environmental Science Services Administration.

ORGANIZATION OF A CONSORTIUM

During the academic year, Professors Garnsey and Haas held a number of meetings with representatives of Colorado State University and the University of Denver to explore the possibilities of a consortium of the three institutions, perhaps in the form of a jointly sponsored Man-Environment Relations Institute. These conversations led to a proposal, "Denver Air Pollution Study: Part I, Design Concepts" submitted to the Department of Health, Education and Welfare.

PROPOSED PROGRAM FOR 1968-69

The proposed program in man-environment relationships for 1968-69 involves:

- (1) continuation of the Faculty Research Seminar and inauguration of interdisciplinary graduate seminars;
- (2) development of additional research proposals, and
- (3) publication of a newsletter or scientific journal of man-environment relationships.

CONTINUATION OF THE FACULTY RESEARCH SEMINAR

The majority of the members of the Seminar have indicated a desire to see it continue and to participate in 1968-69. Additional members of the faculty also have expressed interest in participation. During the year we invited guests from Denver University and Colorado State University to some sessions of the Seminar. We propose to continue and expand this practice in 1968-69. We propose also to encourage the organization of separate seminars on these two campuses providing for joint meetings as well as separate meetings.

There seems to be a general agreement that the Seminar should focus its attention on one or two major problems and that the members should participate more actively in the choice of problems and the discussions of them. Thus, the Seminar probably will be organized around two or three general meetings followed by a series of meetings concentrated on specific topics. These meetings of the Seminar will be divided into two or three working groups with similar interests. It is planned to work out the details of this approach during the summer.

DEVELOPMENT OF ADDITIONAL RESEARCH PROPOSALS

A proposal for planning a comprehensive interdisciplinary research program dealing with air pollution in the Denver airshed was submitted to the Center

for Atmospheric Pollution Control (DHEW) on May 17, under their special Exploratory Grant Program. The first purpose of the Exploratory Grant is to plan the organization and content of a comprehensive interdisciplinary research program dealing with the air pollution problems of the Denver airshed utilizing, cooperatively, the facilities of the University of Colorado, the University of Denver and Colorado State University. The exploratory investigation will be organized, in the first instance, around technological, economic, social and legal aspects of air pollution in the Denver area. In addition to technological considerations, it will include such topics as social attitudes toward air pollution, legal and administrative requirements for air pollution control, and the examination of costs and benefits of alternative methods of, and degrees of control.

The second purpose of the Exploratory Grant is to examine the organizational and administrative problems involved in an inter-institution, interdisciplinary attack on air pollution in order to develop an effective administrative structure for implementation of the long-run research. Thus, our proposal represents an exploration of avenues of inter-university cooperation, through such alternatives as informal agreement, designation of a primary contractor, or a formal consortium.

The investigation during the exploratory period is expected to result in (1) an inventory of current knowledge about air pollution in the Denver airshed, (2) technological applications of pollution control in the Denver area, (3) the discovery of significant lacunas in our present knowledge of this problem, (4) the design of a research project intended to advance knowledge and policy formulation in all aspects of air pollution in the Denver airshed, and (5) establishment of a consortium among the three universities.

It will be noted that this proposal emphasizes the interdisciplinary approach to a specific problem through utilization of the diverse scientific talents of persons attached to three different universities.

PLANS FOR A NEWSLETTER AND A JOURNAL

During the past year we have been in communication with persons interested in man-environment relationships at Washington University, St. Louis, the University of Wisconsin, Madison and Green Bay, George Washington University and others. It appears from these contacts that there is a growing interest in an interdisciplinary approach to man-environment relationships on a number of campuses. It also appears that we are somewhat ahead of other universities in our thinking and in our organization.

Consequently, we have decided to attempt to make the University of Colorado a focal point for man-environment relationships and to perform the function of a clearing house for information about man-environment research and teaching in the United States. This clearing house function involves in the first instance, communication among universities and in the second instance, communication between the universities on one hand and the numerous research and operations agencies of the government on the other. The need for a focusing of information about man-environment relationships has been recognized by NCAR's Task Group on Human Dimensions of the Atmosphere. In their report to the National Science Foundation¹ the following statement may be found:

"A considerable amount of information has accumulated on various aspects of human use of the atmosphere. Unfortunately, much of this information is not available in published form or in convenient locations. The Task Group therefore recommends that the National Science Foundation sponsor a Program for

¹Human Dimensions of the Atmosphere, A Draft Report to the National Science Foundation by the Task Group, W.R.D. Sewell, Chairman, February 1968. Program on Applications Analysis, National Center for Atmospheric Research, Boulder, Colorado, p. 31.

collecting and disseminating bibliographic information and a program for cataloging relevant research efforts to date. These programs should be directed by social scientists knowledgeable in the field of atmospheric resources."

The media for such communication appears to be a Newsletter and a scientific journal. We propose to concentrate next year on the Newsletter and to undertake by this means a systematic survey of what is taking place in the universities in the way of interdisciplinary teaching and research in problems of man-environment relationships. Preliminary plans for compilation of mailing lists, estimation of publication and mailing costs and similar problems have been made. A proposed budget for the publication of the Newsletter is attached.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

May 28, 1968

The following extract from HARVARD TODAY, Spring 1968 is for the information of the Seminar members. Morris E. Garnsey

URBAN STUDIES

A Ford Foundation grant of \$3 million to establish five professorships will strengthen an active program of research and teaching in urban problems now going forward at the University.

The new professorships at Harvard will stimulate new work in such fields as ecology and natural resources, urban economics, education and social structure, urban legal studies, urban sociology, and systems analysis for cities. This work will be located in professional schools of Design, Law, Education and Government, as well as in the central Faculty of Arts and Sciences, and it will supplement work already going on in those and other faculties.

Urban studies have developed rapidly at Harvard during the past eight years under the impetus provided by the Joint Center for Urban Studies of Harvard and M.I.T., created in 1959 with the help of the Ford Foundation. Aspects of the city now are being studied in all parts of the University. Examples:

The Business School is investigating the relevance of management techniques and systems concepts to the physical development of cities.

The Medical School and the School of Public Health are studying ways to develop more comprehensive medical services through integrating community health and welfare resources with programs at Harvard-affiliated hospitals.

The Law School initiated a program of Urban Legal Studies in 1966, including new course and seminar offerings and expanded research, as well as clinical training for students.

There are many other examples of Harvard's current efforts in urban problems.

Air and water pollution problems and the management of natural resources are being studied by experts in the School of Public Health and the Division of Engineering and Applied Physics.

Students in the Harvard Divinity School work with Greater Boston churches in meeting problems of inner-city neighborhoods.

At the School of Government, economists and government experts do research on city problems in the Joint Center for Urban Studies, and on their own; the School also trains students for careers in municipal government, and presents seminars for undergraduates on city issues.

The School of Design has programs aimed at meeting the complexities of designing extensions of urban areas and redeveloping crumbling urban cores; it launched a new Program on Advanced Environmental Studies last fall.

The School of Education carries on studies in, and projects with, many urban school systems, with special emphasis on improving instruction, and helping on problems of integration and equal opportunity.

BIOLOGY: A NEW CENTER

Harvard has a new center for studies in environmental and behavioral biology. Its first chairman, Professor Edward O. Wilson, predicts it will greatly stimulate the "second front" in the biological sciences.

"In recent years," Prof. Wilson says, "the efforts of the biochemist and the molecular biologist to learn how living cells work have been both spectacular and well-publicized. But this is only one approach to the study of life. The physical sciences, on which molecular biology is wholly based, can be addressed to only a small part of the behavior of the whole organism. They will serve in only the most ancillary fashion in our assessment of the tremendous variety of plants and animals on earth and the unique ways individual species have evolved to flourish in particular environments. A stronger effort is called for along this second, less active front of biology."

Thus the Center has been established as a central platform for Harvard's research and teaching efforts concerned with the whole organism in relation to the environment.

13 May 1968

TO: Members of the Faculty Research Seminar in Man-Environment Relationships
FROM: David J. Rogers, Biology Department
SUBJECT: Botanic Garden for the Rocky Mountains?

We would like to invite you to hear Dr. Warren H. Wagner, Director of the University of Michigan Botanic Garden, who will present a seminar on The Role of a Botanical Garden in a University, on Tuesday afternoon, May 21, at 4:00 P.M., Hafe Hall, Room 102.

Dr. Wagner has been invited to share with us some ideas on the proper role of a Botanic Garden within the academic community and in the surrounding city. We hope that we can ask each of you to consider with us (as we develop our ideas) what integrated efforts we might put a botanic garden to along the lines of our research seminar. Let it be said that a botanic garden can be a place other than to raise pretty flowers. Perhaps you may be stimulated to think about these potentials when you hear Dr. Wagner.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

April 23, 1968

TO: MEMBERS OF THE SEMINAR
FROM: MORRIS E. GARNSEY, CHAIRMAN

This notice is to remind you of the next meeting of the Seminar in Man-Environment Relationships which will be held on Wednesday, May 8 at 3:00 p.m. in the University Memorial Center, room 158A.

Our guest speaker will be Dr. Edward W. Weidner, Chancellor of the University of Wisconsin-Green Bay.

A brief biography of Dr. Weidner follows:

B.A., University of Minnesota, 1942 - Political Science
M.A., 1943 and Ph.D., 1946, University of Minnesota
Professor at U.C.L.A. and Michigan State. Director of
Government Research Bureau, Michigan State. Considerable
experience in Vietnam both at Michigan State and more
recently. Spent some time at East-West Center, University
of Hawaii. Author of various publications in the field
of political science and American Government.

I am enclosing an extract from The University of Wisconsin-Green Bay Statement of Philosophy and Undergraduate Program

Extract from:

THE UNIVERSITY OF WISCONSIN-GREEN BAY

STATEMENT OF PHILOSOPHY

AND

UNDERGRADUATE PROGRAM

January 5, 1968

A Focus on Ecology

Environmental crises characterize much of the present condition of man. The situations comprising this condition are headlined daily: problems of urbanization, racial crisis, population explosion, the cold - and hot - wars, crisis of transportation, effects of automation, crisis of environmental pollution, threatened water shortage, threatened food shortage, and impending exhaustion of fossil fuels. These problems have been confounded by feedback from attempts to solve one or another of them unilaterally. For example, just when biological productivity must be enhanced, biocides threaten to disrupt the biosphere. Just when plans mature consciously to modify weather processes, it is discovered that air pollution has already set in motion widespread inadvertent weather modification, the consequences of which can now be only dimly perceived.

These are not light problems. They are the crises of man's destiny. Because they stem fundamentally from man's relation to and use of his environment, from interactions among men, and from man's perception of his place in the biosphere, man must actually deal with aspects of only one crisis, namely an ecological crisis.

The problems that are the essence of this ecological crisis are admittedly complex and there are no ready solutions. Solutions, however, must be urgently sought. The decisions made in the next few decades will truly determine human destiny. The strategic approach to these problems must arise from an effective consortium of government, industry, agriculture, university, and community.

In this consortium the university has to play a role of leadership. Ecological problems are truly exciting and they are worthy of the most serious

attention from scholars and students. Because there is now little basic information on which to erect solutions to these ecological problems, the universities must shoulder the responsibilities of leadership, move out of insular laboratories into the human environment, and attack these problems for their own sake with substantial vigor.

The University of Wisconsin-Green Bay has determined to meet these challenges of responsibility and focus on ecology, including the ecological crises, as its special scholarly activity. It does so as a part of its responsibility in being faithful to the mission of The University of Wisconsin and as one of its full collegiate institutions. The mission of The University of Wisconsin is laid down both in the Constitution of Wisconsin and in Chapter 36 of the Wisconsin Statutes. Specifically, the Board of Regents is given authority and responsibility of developing teaching, research, and public service or extension activities. An ecological or environmental approach to knowledge requires higher education to forge combined programs of teaching, research, and extension, in contrast to developing separate programs for each of these three areas of responsibility. For example, if the problem under review is river valley development, an undergraduate teaching program gains strength and quality from being associated with graduate, research, and extension programs concentrating on the same problem. All of higher education becomes of one piece.

Focus on the crises of ecology or environment enhances the opportunity of a university to strengthen the sense of commitment of young adults and relate their commitment to that of the rest of the community. The accumulation of knowledge during undergraduate and graduate days becomes intimately related to

major problems facing men everywhere as well as to important scientific problems and theories. The excitement of learning is related to the challenge of bringing about a better world.

An ecological focus is an interdisciplinary - indeed, a pan-disciplinary - focus. Artificial boundaries of disciplines restrict rather than enhance understanding of the several environments of man. The boundaries of knowledge that are relevant to the study of any type of environment intersect many disciplines representative of all branches of knowledge - the physical, biological, and behavioral sciences and the humanities. Ecology is a focus that is broadening and liberal in its educational tone, not specializing or restrictive.

In regard to theory and research, ecology provides many opportunities for systems analyses. Input - output models are especially applicable. Theoretical and research work can be carried out at the more general levels or at intermediate or the most applied levels. And ecology also provides a promising area for the creative artist.

The study of man in his environments is an approach to knowledge that demands close collaboration between a university and its community. The University of Wisconsin-Green Bay is ideally situated in this regard. Northeastern Wisconsin was intimately involved in the origin of the institution and participated in its planning. Notably, members of the community identified a number of ecological problems as those upon which they would most like to see the new institution focus. The regional identity of both Northeastern Wisconsin and the larger Northern Great Lakes region and community concern and support for UWG and its several campuses make possible true areawide cooperation in attacking ecological problems.

World ecological crises have particular reflections in the Northern Great Lakes region, Canada, the Middle North, and Arctic on which the university is placing special emphasis. Collaboration between a university and its community on ecological problems is thus not a narrowing or parochial approach to knowledge. It is comparative in spirit. Comparisons between the Northern Great Lakes region and other parts of the world are an integral part of the educational plan.

A Theme College Form of Organization

The spirit of ecological enquiry is pan-disciplinary. Consequently, the University of Wisconsin-Green Bay is organized by colleges based upon environmental themes rather than by colleges grouped according to disciplines. The four themes are physical environment, social environment, the impingement of environment on an individual, and an individual's impingement on or contribution to the environment. Respectively, the colleges are the College of Environmental Sciences, the College of Community Sciences, the College of Human Biology, and the College of Creative Communication. Each of them is based heavily both on selected aspects of the liberal arts disciplines and on certain applied or professional areas. Each theme college has responsibility for a coordinated program of undergraduate and graduate studies, research, and public service programs relative to its special environmental concern. A college is responsible for developing its own course structure at all levels. Interdisciplinary courses are frequent, and interdisciplinary concentrations are required. Consequently, team teaching - the utilization of faculty members of two or more disciplines in a single course - is commonly encountered.

A theme college offers distinctive general or liberal education seminars for its undergraduate student members in their sophomore and junior years, complementing university-wide freshman and senior seminars. During the intermediate two years, each seminar is grouped around some aspect of the environmental focus of the college. The purpose is not to make specialists of the students, but to introduce them to the knowledge of many disciplines as they relate to man's environment.

As undergraduate students begin to specialize, their interests in particular disciplines are related to certain environmental problems. The reciprocal is also true: their interests in certain environmental problems are related to particular disciplines. Thus a student who comes to the university primarily interested in chemistry is able to choose whether he wants to relate chemistry to problems of the physical environment (College of Environmental Sciences) or problems of the environment's impingement on individuals (College of Human Biology). A student who comes primarily interested in water pollution or natural resources is able to relate his concern to one or more disciplines such as physics, chemistry, biology, the social sciences, and the fine arts.

A Multi-Campus University

The University of Wisconsin-Green Bay is a single multi-campus university, with campuses at Marinette, the Fox Valley, and Manitowoc as well as the central campus at Green Bay. Students may take work at any of the campuses, in any combination or proportion. Most of the more advanced or specialized courses are available primarily in Green Bay. Faculty members normally teach at more than one campus. A common library is shared. Interconnections among

the several locations will soon be furthered by a substantial telecommunications system.

On the new central campus at Green Bay, each college has been assigned a particular portion of the campus so as to enhance its identity and strengthen the interchange among students, faculty, and community. As the University becomes larger, the theme colleges will help assure the advantages of smallness in bigness. Immediate reference groups of students will remain small--perhaps as few as 1,250--through relating each student to a particular study-social center of each theme college, used by both commuting and dormitory students alike. Dormitories (and commuter parking lots as well) are being clustered within each theme college so that experimental living-learning or residential college programs can be carried out on a selective basis as desired.

A very large addition to the campus at Marinette is now under construction, and discussions are underway concerning physical plans for the Fox Valley campus. In the case of all campuses, each of the theme colleges will be represented.

The multi-campus feature of UWG is closely allied to its participant education and ecological foci. It reflects a closeness of town and gown, of university and community, of learning and action. It facilitates a study of environments in the Northern Great Lakes region.

In sum, the University of Wisconsin-Green Bay is channeling its efforts in an exciting direction. Meaningful and effective contributions to a society by its citizens; the physical, mental, and social well-being of individuals; community development; a physical environment that permanently enhances life--these are noble objectives. By means of public service, research, and undergraduate and graduate teaching programs, The University of Wisconsin-Green Bay is committed to contributing to their realization.

THE UNDERGRADUATE PROGRAM

An undergraduate experience is a liberating experience. It is the liberating of the souls of students by development of their processes of thinking and review and reinforcement of their values and sense of commitment-- all in a context of additional knowledge and experience. To this end, The University of Wisconsin-Green Bay has established certain all-University requirements.

The Liberal Education Seminars

The central core of liberal education at the University of Wisconsin-Green Bay is a four-year series of seminars known collectively as the Liberal Education Seminars. It is through this sequence that the student receives an introduction to values, ecology, and environment, obtains special knowledge about certain ecological problems and has an opportunity to relate his experiences, interests, and concerns to those who have different and complementary ones. Each year's work carries six credits, although the sophomore and junior practica may in some instances carry additional credit.

THE FORD FOUNDATION
320 EAST 43RD STREET
NEW YORK, NEW YORK 10017

DIVISION OF NATIONAL AFFAIRS
RESOURCES AND ENVIRONMENT

April 17, 1968

Professor Morris E. Garnsey
University of Colorado
Department of Economics
Boulder, Colorado 80302

Dear Professor Garnsey:

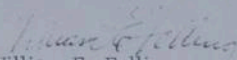
Your letter of March 29 with the enclosed preliminary draft proposal for a planning conference directed toward organization in Colorado of a consortium for research and education in man-environment relationships not only caught me unawares but raises some doubts in my mind.

During my visit in November 1967, we discussed the need to strengthen the social science inputs to the resource management decision processes that are now so strongly dominated by technological and economic considerations. I understood that the University of Colorado was going to study in detail a possible graduate program that might begin to answer that need.

Recognizing the difficulties of developing such a program within a university as large and diverse as Colorado, I wonder if a consortium of such institutions doesn't just compound the problem? Our experience in assisting inter-university projects does not leave us sanguine. We frankly feel that our limited funds should be invested in less ambitious, more sharply focussed undertakings.

For that reason I cannot encourage you to submit a formal proposal. I am sorry to disappoint you, but I know you will understand that whatever the merits of a proposal, we must be guided by our judgment of how the Foundation can be most effective.

Sincerely yours,


William E. Felling
Program Officer

Minutes of Meeting of the Seminar on Man-Environment Relations

April 10, 1968

by

Kenneth Boulding

Litigation in the Courts
Is very good where there are torts,
Though actions that we are demanding
May be deterred by lack of standing.
Though litigation is a tortoise
And often in delays has caught us,
Yet sometimes it can get somewhere
Before the Legislative hare.

Before the Engineer can toddle
He makes a quantitative model
With lots of x's, y's, and z's
To substitute for ABC's.
But engineers don't have the pull
Their Dozers are a lot of Bull,
In Real (or Realtor) life, what follers?
Systems suboptimize the dollars.

Biologists create an aura
Around the fauna and the flora
That are produced in various locuses
By lengthy ecologic processes.
They tend to think that errant Man
Is not included in the plan,
And if he jumped into the lake
Would end Mutation's first mistake.

The Redwoods, just by growing higher
Survive both flood and forest fire,
So Man, by stopping fire and flood,
Don't do the Redwoods any good
And likewise, though we don't know how,
The cactus can't survive the cow.
And in Alaska, wolves can do
A lot of good to caribou.

Environmental politics
Is Man, engaged in various tricks,
Administratedly, of these,
The trickiest are subsidies.
The life of animals and plants
Is often in the hands of grants,
And man himself becomes mere loot
In inter-agency dispute.

Economists, in trying to fit
The cost into the benefit,
Point out that it is always wise,
In making choice, to optimize.
The one conclusion we arrive at
Is making Social equal Private
And so with Algebra and Zest
We earnestly pursue the Best.

CAN THE WORLD BE SAVED

by

LaMont C. Cole

"The answer isn't quite an unequivocal no - but,
'in seeking a better way of life, man is destroying
the natural environment essential to any life at
all.'"

Reprinted from The New York Times Magazine
March 31, 1968 - Section 6

My title here is not my first choice. A year or so ago, a physicist discussing some of the same subjects beat me to the use of the title I would have preferred: "Is There Intelligent Life on Earth?" There is evidence that the answer to both questions is in the negative.

In recent years, we have heard much discussion of distinct and nearly independent cultures within our society that fail to communicate with each other -- natural scientists and social scientists, for example. The particular failure of communication I am concerned with here is that between ecologists on the one hand and, on the other, those who consider that continuous growth is desirable -- growth of population, industry, trade and agriculture. Put another way, it is the dichotomy between the thinkers and the doers--those who insist that man should try to know the consequences of his actions before he takes them versus those who want to get on with the building of dams and canals, the straightening of river channels, the firing of nuclear explosives and the industrialization of backward countries.

The message that the ecologists--the "thinkers," if you will--seek to impart could hardly be more urgent or important. It is that man, in the process of seeking a "better way of life," is destroying the natural environment that is essential to any kind of human life at all; that, during his time on earth, man has made giant strides in the direction of ruining the arable land upon which his food supply depends, fouling the air he must breathe and the water he must drink and upsetting the delicate chemical and climatic balances upon which his very existence depends. And there is all too little indication that man has any intention of mending his ways.

The aspect of this threat to human life that has received the least public attention, but which is, I believe, the most serious is the manner in which we are altering the biological, geological and chemical cycles upon which life depends.

When the world was young, it did not have the gaseous atmosphere that now surrounds our planet. The water that fills the oceans and furnishes our precipitation, and the nitrogen that makes up most of our atmosphere, were contained in the rocks formed in the earth's creation. They escaped by various degassing processes, the most dramatic of which was volcanic action.

The amount of oxygen in the atmosphere was negligible before the origin of living organisms that could carry on photosynthesis of the type characterizing green plants, which during daylight hours take in carbon dioxide and give off oxygen. At first, there was virtually no accumulation of oxygen in the atmosphere. The oxygen produced by marine organisms was used by a combination of natural biogeochemical processes which are still operative today - the liberation of incompletely oxidized iron salts in the weathering of silicate rocks and the decomposition of organic matter. But very gradually, some dead organisms began to pass out of circulation by being deposited in sedimentary rocks where some of them became the raw material for the creation of coal and oil. The oxygen that these well-buried organisms would have used up, had they remained on the surface and been subject to decomposition, was allowed to remain in the atmosphere. And eventually, perhaps not until 400 million years ago, this unused oxygen brought the level of oxygen in the atmosphere to slightly over 20 per cent.

This is the same percentage of oxygen in the atmosphere today. Apparently, the combination of green plants and oxygen-using organisms, including animals, became very efficient at taking oxygen from the atmosphere and returning it at equal rates. And this is true in spite of the fact that photosynthesis stops during the hours of darkness and practically stops during winter on land areas in high latitudes. It does continue, however, in low latitudes (although often greatly reduced by seasonal drought) and in the ocean (where marine

micro-organisms suspended in water near the surface produce 70 per cent or more of the world's photosynthetic oxygen). And we have been fortunate that atmospheric circulation patterns move the air about the globe in such a way that we have not had to be concerned that man would run out of oxygen to breathe at night or in winter. As we shall see, man is today pushing his luck.

Another chemical element essential to life is carbon. Plants use carbon dioxide to build their organic compounds, and animals combine the organic compounds with oxygen to obtain the energy for their activities. And all this is possible only because, millions of years ago, the deposition of organic matter in sedimentary rocks led to the creation of a reservoir of oxygen in the atmosphere.

The carbon-oxygen relationship is essential to photosynthesis and thus to the maintenance of all life. But should this relationship be altered, should the balance between the two be upset, life as we know it would be impossible. Man's actions today are bringing this imbalance upon us.

The carbon dioxide in the atmosphere is created in large measure by combustion. Before the time of man, the combustion in the earth's forests was spontaneous. Early man set forest fires to drive game and burned timber for warmth; he went on to find other uses for combustion and to find new combustible materials. First it was coal for heat and power, then oil and natural gas. The exploitation of these so-called fossil fuels made it possible for more people to exist on earth simultaneously than has ever been possible before. It also brought about our present dilemma: The oceans are the world's great reservoir of carbon, taking carbon dioxide from the atmosphere and precipitating it as limestone; we are now adding carbon dioxide to the atmosphere more rapidly than the oceans can assimilate it.

Industrial facilities, automobiles and private homes are the big consumer of fossil fuels, but to appreciate the magnitude of the problems, consider very briefly a still minor source of atmospheric pollution, the airplane, which may have disproportionate importance because much of the carbon dioxide and water vapor produced by the combustion in its engines are released at high altitudes, where they are only slowly removed from the atmosphere.

When you burn a ton of petroleum hydrocarbon, you obtain as by-products about one and a third tons of water and about twice this amount of carbon dioxide. A Boeing 707 in flight accomplishes this feat about every 10 minutes. I read in the papers that 10,000 airplanes per week land in New York City alone, not including military aircraft. If we assume very crudely that the 707 is typical of these airplanes, and that its average flight takes four hours, this amounts to an annual release into the atmosphere of about 36 million tons of carbon dioxide. And not all flights have a terminus in New York.

Thus the amount of carbon dioxide put into the atmosphere is rising at an ever-rising rate. At the same time, we are removing vast tracts of land from the cycle of photosynthetic production - in this country alone, nearly a million acres of green plants are paved under each year. The loss of these plants is drastically reducing the rate at which oxygen enters the atmosphere. And we do not even know to what extent we are inhibiting photosynthesis through pollution of fresh-water and marine environments.

The carbon-oxygen balance is tipping. When, and if, we reach the point at which the rate of combustion exceeds the rate of photosynthesis, we shall start running out of oxygen. If this occurred gradually, its effect would be approximately the same as moving everyone to a mountaintop - a change that might help to alleviate the population crisis by raising death rates. However, the late Lloyd Berkner, director of the Graduate Research Center of the Southwest, thought that atmospheric depletion might occur suddenly.

The increase in the proportion of carbon dioxide in the atmosphere will have other effects. Carbon dioxide and water vapor are more transparent to shortwave solar radiation than to the longwave heat radiation from the earth to space. Thus the increased proportion of these substances in the atmosphere tends to bring about a rise in the earth's surface temperature, the so-called greenhouse effect, altering climates in ways that are still highly controversial in the scientific community but that everyone agrees are undesirable.

One school holds that the increase in temperature will melt the icecaps of Greenland and the Antarctic, raising the sea level by as much as 300 feet and thereby obliterating most of the major cities of the world. Another school believes that higher temperatures will bring about an increase in evaporation and with it a sharp rise in precipitation; the additional snow falling upon the icecaps will start the glaciers moving again, and another Ice Age will be upon us.

And these represent only the lesser-known effects of combustion on the world. They do not include the direct hazards from air pollution - on man's lungs, for example, or on vegetation near some kinds of industrial plants. Nor do they include the possibility, suggested by some scientists, that we will put enough smoke particles into the air to block solar radiation, causing a dangerous decrease in the earth's temperature. Just to indicate the complexity and uncertainty of what we are doing to the earth's climates, I should mention that the smoke-caused decrease in temperatures would most likely be offset by the carbon dioxide-caused greenhouse effect.

In any case, if we don't destroy ourselves first, we are eventually going to run out of fossil fuels - a prospect surely not many generations away. Then, presumably, we shall turn to atomic energy (although, like the fossil fuels, it represents a non-renewable resource; one would think that its present

custodians could find better things to do with it than create explosions). And then we will face a different breed of environmental pollution.

I am aware that reactors to produce electricity are already in use or under development, but I am apprehensive of what I know of the present generation of reactors and those proposed for the future.

The uranium fuel used in present reactors has to be reprocessed periodically to keep the chain reaction going. The reprocessing yields long-lived and biologically hazardous isotopes such as ⁹⁰Strontium and ¹³⁷Cesium that should be stored where they cannot contaminate the environment for at least 1,000 years; yet a goodly number of the storage tanks employed for this purpose are already leaking. At least these products of reprocessing can be chemically trapped and stored; another product, ⁸⁵Krypton, cannot be so trapped - it is sent into the atmosphere to add to the radiation exposure of the earth's biota, including man, and I don't think that anyone knows a practicable way to prevent this.

To soothe our concern about the pollution of the environment involved in fission reactors, we are glibly offered the prospect of "clean" fusion bombs and reactors. They do not require reprocessing and thus would not produce the Strontium, Cesium and Krypton isotopes. But to the best of my knowledge, no one knows how this new generation of reactors is to be built. And even if development is successful, fusion reactors will produce new contaminants. One such is tritium (³Hydrogen) which would become a constituent of water - and that water with its long-lived radioactivity would contaminate all environments and living things. The danger of tritium was underlined in an official publication of the Atomic Energy Commission in which it was suggested that for certain mining operations it might be better to use fission (i.e. "dirty") devices rather than fusion (i.e. "clean") devices "to avoid ground water contamination."

A prime example of what irresponsible use of atomic power could bring about is provided by the proposal to use nuclear explosives to dig a sea-level canal across Central America. The argument in its favor is that it is evidently the most economical way to accomplish the task. Yet consider the effects upon our environment. If 170 megatons of nuclear charges will do the job, as has been estimated by the Corps of Engineers which apparently wants to do it, and if the fission explosions take place in average materials of the earth's crust, enough $^{137}\text{Cesium}$ would be produced to give every person on earth a radioactive dosage 26.5 times the permissible exposure level. Cesium behaves as a gas in such a cratering explosion, and prevailing winds in the region are from east to west, so the Pacific area would presumably be contaminated first. And Cesium moves right up through biological food chains, so we could anticipate its rapid dissemination among living things.

The sea-level canal proposal also poses other dangers, whether or not atomic explosives are used. In that latitude, the Pacific Ocean stands higher than the Atlantic by a disputed amount I believe to average 6 feet. The tides are out of phase on the two sides of the Isthmus of Panama, so the maximum difference in level can be as great as 18 feet; and the Pacific has much colder water than the Atlantic.

Just what would happen to climates or to sea food industries in the Caribbean if a new canal moved a mass of cold Pacific water in there is uncertain; but I have heard suggestions that it might create a new hurricane center, or even bring about diversion of the Gulf Stream with a drastic effect on the climates of all regions bordering the North Atlantic. We know that the sea-level Suez Canal permitted the exchange of many marine species between the Red Sea and the Mediterranean. We know that the Welland Canal let sea lampreys and alewives enter the upper Great Lakes with disastrous effects on fisheries and, more recently, on bathing beaches. We just don't know what disruptions of this sort of sea-level canal in the Isthmus might cause.

So much of the danger to man is summed up in that simple phrase, "We don't know." For example, consider the nitrogen cycle, which provides that element all organisms require for the building of proteins. Nitrogen is released into the atmosphere, along with ammonia, as a gas when plants and animals decay; live plants use both elements to build their proteins, but they cannot use nitrogen in gaseous form - that task is accomplished by certain bacteria and primitive algae in the soil and the roots of some plants. Animals build their proteins from the constituents of plant proteins. As in the case of oxygen, the rates of use and return of nitrogen have reached a balance so that the percentage of nitrogen in the atmosphere remains constant.

If any one of these numerous steps in the nitrogen cycle were to be disrupted, disaster would ensue for life on earth. Depending upon which step broke down, the nitrogen in the atmosphere might disappear, it might be replaced by poisonous ammonia, or it might remain unused in the atmosphere because the plants could not absorb it in gaseous form.

Are any of these possibilities at hand? Has man's interference with natural processes begun to have a serious effect on the nitrogen cycle? The point is, we don't know - and we should, before we do too much more interfering.

We are dumping vast quantities of pollutants into the oceans. According to one estimate by the United States Food and Drug Administration, these include a half-million substances; many are of recent origin, including biologically active materials such as pesticides, radioisotopes and detergents to which the ocean's living forms have never before had to try to adapt. No more than a minute fraction of these substances or the combinations of them have been tested for toxicity to life - to the diatoms, the microscopic marine plants that produce most of the earth's oxygen, or to the bacteria and microorganisms involved in the nitrogen cycle.

If the tanker Torrey Canyon had been carrying a concentrated herbicide instead of petroleum could photosynthesis in the North Sea have been stopped? Again, we don't know, but Berkner is said to have believed that a very few ^{cases} instances of herbicide pollution, occurring in certain areas of the ocean that are high in photosynthetic activity, might cause the ultimate disaster.

Man has developed ingenious products and devices to bring about short-range benefits. He is constantly devising grandiose schemes to achieve immediate ends - the UNESCO plan of 20 years ago, for example, to "develop" the Amazon basin, which I am happy to say has since been judged impracticable. Surely man's influence on his earth is now so predominant, so all-pervasive, that he must stop trusting to luck that his products and schemes will not upset any of the indispensable biogeochemical cycles.

The interference with these delicately balanced cycles is not, however, the only instance of man's misuse of his natural heritage. He has also succeeded in rendering useless huge tracts of the earth's arable land.

We hear a lot today about "underdeveloped" and "developing" nations, but many of them might more accurately be called "overdeveloped." The valleys of the Tigris and Euphrates Rivers, for example, were supporting the Sumerian civilization in 3500 B.C. By the year 2000 B.C., a great irrigation complex based on these rivers had turned the area into the granary of the great Babylonian Empire (Pliny says that the Babylonians harvested two crops of grain each year and grazed sheep on the land between crops). But today less than 20 per cent of the land in Iraq is cultivated; more than half of the nation's income is from oil. The landscape is dotted with mounds, the remains of forgotten towns; the ancient irrigation works are filled with silt, the end product of soil erosion, and the ancient seaport of Ur is now 150 miles from the sea, its buildings buried under as much as 35 feet of silt.

The valley of the Nile was another cradle of civilization. Every year the river overflowed its banks at a predictable time, bringing water to the land and depositing a layer of soil rich in mineral nutrients for plants. Crops could be grown for seven months of the year.

Extensive irrigation systems were established in the valley before 2000 B.C. The land was the granary of the Roman Empire, and continued to flourish for another 2,000 years. But in modern times, economic considerations have inspired governments to divert the land from food to cash crops such as cotton in spite of the desperate need for more foodstuffs to feed a growing population. In 1902 a dam was built at Aswan to prevent the spring flood and to make possible year-round irrigation, and since then the soils have deteriorated through salinization and productivity in the valley has decreased.

Salinization is a typical phenomenon of arid regions where evaporation is greater than precipitation. Rainwater soaks into the earth, dissolving salts as it goes; when the sun appears, evaporation at the earth's surface draws this salty water upward by capillary action; and when this water in turn evaporates, it leaves a deposit of salts on the surface. The essential condition for salinization to take place is a net upward movement of water. Irrigation in arid areas, though it may have short-range benefits, can also be fraught with long-range dangers. The large quantities of water used in irrigation are added to the water table, raising it to the level of the irrigation ditch bottom - that is to say, the ground below that point is saturated with water. Otherwise, of course, the water in the ditches would soak right down into the earth immediately below, rather than spreading outward to nourish land on either side. But this results in a sideward and then upward movement of the irrigation water toward the surface. And when the salt-laden water reaches the surface and evaporates, salinization occurs. Unless great care is

taken, irrigation can thus eventually ruin land - and it has often done so. The new Aswan high dam is designed to bring another million acres of land under irrigation, and it may well prove to be the ultimate disaster for Egypt.

Such sorry stories could be told for country after country. The glories of ancient Mali and Ghana in West Africa were legends in medieval Europe. Ancient Greece had forested hills, ample water and productive soil. In the land that once exported the cedars of Lebanon to Egypt, the erosion-proof old Roman roads now stand several feet above a rock desert. In China and India ancient irrigation systems stand abandoned and filled with silt.

When the British assumed the rule of India two centuries ago, the population was about 60 million. Today it is about 500 million, and most of the nation's land problems have been created in the past century by deforestation and plowing and the resulting erosion and siltation, all stemming from efforts to support this fantastic population growth.

Overdevelopment is not confined to the Old World. Archaeologists have long wondered how the Mayas managed to support what was obviously a high civilization on the now unproductive soils of Guatemala and Yucatan. Evidently they exploited their land as intensively as possible until its fertility was exhausted and their civilization collapsed.

As recently as the present decade, aerial reconnaissance has revealed ancient ridged fields on flood plains, the remnants of a specialized system of agriculture that is believed to have transformed much of South America. This same system of constructing ridges on seasonal swamps - to raise some of the land above the flood level for planting and to capture some of the flood water - has been observed in Tanzania in Africa. The South American ridges occur in areas now considered unfit for agriculture; and though any cause and effect relationship between ridges and land ruin has not been established for those areas, it has been demonstrated in Africa where the practice is known to accelerate erosion.

Even our own young country has not been immune to deterioration. We have lost many thousands of acres to erosion and gullying and many thousands more to strip mining. It has been estimated that the agricultural value of Iowa farmland, which is about as good land as we have, is declining by 1 per cent per year. In our irrigated lands of the West there is the constant danger of salination.

We have other kinds of water problems as well. We are pumping water from wells so much faster than it can be replaced that we have drastically lowered water tables; in some coastal regions the water table has dipped below sea level, with the result that salt water is seeping into the water-bearing strata. Meanwhile, an estimated 2,000 irrigation dams in the United States have become useless impoundments of silt, sand and gravel.

So this is the heritage of man's past - an impoverished land, a threat to the biogeochemical cycles. And what are we doing about it?

I don't want to comment on the advertising executive who asserts that billboards are "the art gallery of the public" or on the industry spokesman who says that "the ability of a river to absorb sewage is one of our great natural resources and should be utilized to the utmost." In the face of such self-serving statements, the efforts of those who try to promote conservation on esthetic grounds seem inevitably doomed. It makes one wonder, are we selecting for genotypes who can satisfy all their esthetic needs in our congested cities? Are the Davy Crocketts and Kit Carsons who are born today destined for asylums, jail or suicide?

There have been suggestions made for new ways to supplement the world's food production. We hear talk of farming the ocean bottoms, for example. And there are efforts to use bacteria, fungi or yeasts to convert petroleum directly into food for man. This is superficially attractive because it appears to be more efficient than first feeding the petroleum to a refinery and then the

gasoline to tractors and other machines which eventually deliver food to us. But it is a melancholy fact that the metabolism of bacteria, fungi and yeasts does not generate oxygen - as do the old-fashioned green plants.

What alarms me most is that only infrequently, and usually in obscure places, does one come across articles by authors who recognize that no matter what we do, it is impossible to provide enough food for a world population that increases at a compound interest rate of 1.7 per cent a year. Thus, there appears to be no way for us to escape our dependence on green plants; and even with them, there is no way for us to survive except to halt population growth completely or even to undergo a period of population decrease if, as I anticipate, definitive studies show our population to be already beyond what the earth can support on a continuous basis. Just as we must control our interference with the chemical cycles that provide the atmosphere with its oxygen, carbon and nitrogen, so must we control our birth rate.

In order to accomplish this end, natural scientists, social scientists and political leaders will have to learn to overcome that failure of communication which I referred to earlier. And all three will have to learn to communicate with the general public. This is a large order, but I have found in recent years that intercommunication is possible between ecologists and social scientists who are concerned with population problems.

For example, as a natural scientist, it would not occur to me that in many cultures it is important to save face and prove virility by producing a child as soon after marriage as possible. In these cultures, population planners must evidently aim at delaying the age of marriage or spreading the production of children after the first. And after it has been pointed out to me, I can easily see that a tradition to produce many children would develop under social conditions where few children survive to reach maturity and families wish to assure they will have descendants.

In a Moslem country like Pakistan, where women will not allow themselves to be examined by a male physician, birth control by such measures as the Intrauterine device (IUD) is impracticable, and it is difficult to convey a monthly schedule of pill-taking to the poorly educated. However, just as the reproductive cycles of cattle can be synchronized by hormone treatments so that many cows can undergo simultaneous artificial insemination, so the menstrual cycles of populations of women can be synchronized. Then the instructions for contraception can take such a simple form as: "Take a pill every night the moon shines." But in a country like Puerto Rico the efforts of an aroused clergy to instill guilt feelings about the decision a woman must make each day can render the pill ineffective. Here, the IUD, which requires only one decision, provides an answer.

In any case, there is ample evidence that people the world over want fertility control. Voluntary sterilization is popular in India, Japan and Latin America. In Japan and Western European countries that have made legal abortion available upon request the birth rates have fallen dramatically. With such recent techniques as the pill and the IUD, and the impending availability of antimeiotic drugs which inhibit sperm production in the male, and antiimplantation drugs which can prevent pregnancy when taken as long as three days after exposure, practicable fertility control is at last available.

Kingsley Davis, a population expert at the University of California at Berkeley, has recently expressed skepticism about schemes for family planning on the grounds that they do not actually represent population policy but merely permit couples to determine their family size voluntarily. This is certainly true, but the evidence is overwhelming that a great many of the children born into the world today are unwanted. I think we must start by preventing these unwanted births and then take stock of what additional measures, such as negative dependency allowances, may be called for.

Japan has already shown that a determined people can in one generation bring the problem of excessive population growth under control. The Soviet Union seems finally to have abandoned the dogma that overpopulation problems are byproducts of capitalism and couldn't exist in a socialistic country. So a beginning has been made. It now becomes more urgent that social and natural scientists get together and try to decide what an optimum size for the human population of the earth would be.

I shall try to end on a note of optimism. We have seen the start of efforts at meaningful birth control. A five-year study, known as the International Biological Program, is investigating the effects that man is having on the environment. If the world's best minds can at last come to grips with the population problem and effect its control, and if this can be achieved before some miscalculation, or noncalculation, sends the earth environment into an irreversible decline, then there indeed may be some hope that the world can be saved.

Dpt. Gen.

FROM: ARID LANDS RESEARCH NEWSLETTER (April, 1968)
Committee on Desert and Arid Zones Research (CODAZR)
American Association for the Advancement of Science
Southwestern & Rocky Mountain Division

EDITORIAL---FUTURE ENVIRONMENTS OF ARID LANDS OF SOUTHWESTERN
UNITED STATES

Man arrived in southwestern United States some 15,000 years ago after a long and arduous journey, presumably across the Bering Strait. Since then, he has lived in these arid regions almost continuously, first as a hunter of big game, then as a gatherer of native foods, then as an agriculturist. Some of the techniques of these early people were advanced even by today's standards, the Hohokams having irrigated more than 100,000 acres which fed a population of more than 50,000. We are still learning about the culture of these most interesting people and how they coped with the problems of existence in an arid land.

In recent years the white man and his technology have "discovered" the desert. The first thrust began with the nation's first reclamation project, Theodore Roosevelt Dam, which was constructed in 1911, accelerated markedly with the development of evaporative cooling for homes; and became a flood with the development of refrigerated air conditioning. The electronics industry discovered that the low humidity was ideal for the manufacture and assembly of transistors; tourists discovered a relaxed way of life in the sun; con men found a lucrative place to spend the winter.

The states in the arid southwest, Arizona, Nevada, New Mexico, southern California, western Texas have experienced the most dramatic population growth in the United States. With the population of the United States projected to increase to more than 330 million people by the year 2000 the migrations to the arid regions threaten to inundate them.

What plans are being made to meet this invasion? Unfortunately none. We live from day to day, from water crisis to the next, and from one land swindle to the next. It is high time we asked ourselves "What will be the future environment in the arid lands of southwestern United States?"

The answer to this question depends upon your point of view. Urban planners visualize the growth of ever expanding urban centers with subdivision being laid down in annular rings, the width of which reflect the effects of the environmental factors of interest rates, tight money, election years, and the current status of unceasing international strife. Regional planners talk glibly about green

belts, human ecology, cultural shifts, dynamic balance and come up with marvelously vacuous definitions. Engineers visualize glistening monuments of concrete damming the rivers, flooding the canyons, and standing as silent witnesses to the power of the slide rule and the "pork barrel."

Sociologists speak of fulfillment, sensory input, communion with nature, leisure time, LSD, and posterity. Economists talk of gross national product, automation, cybernetics, economic patterns and processes. Ecologists worry about endangered species, endangered habitats, niches, ecosystems and biotopes. Agriculturists collect crop subsidies and work for higher tariffs on cotton. Cattlemen support the bounty on mountain lions.

Somewhere in this welter of confusion and greed there must be a nucleus around which a start may be made in planning what the future environments of these arid lands will be. This will be the topic of the symposium to be presented at the 45th annual meeting of the Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science in May, 1969. The symposium will be sponsored by the Committee on Desert and Arid Zone Research.

Gordon L. Bender, Department of Zoology
Arizona State University, Tempe, Arizona

Corbridge

4/10/68

No legal res. on human improvement
or environment

Possibilities -

1. Should be good or action-oriented.
2. Specifically can do
 1. Providing techn. of prevention
 2. Creation
 3. Anticipating problems.
- 1) share legal action (suits, litigation) to improve envir. -
Pesticide suits, for ex.
Basic res. in
2. Creation - no past cases,
∴ no precedents
Use mod. communication
methods to dig out cases
in environmental problems.

Concepts of weather modification
do not fit into parameters
of common law -

Biologist's point of view.

1. To study biology (an inclusive word) in the broadest context
 - a. Remember man as the dominant element.
 - b. Consider (if possible) the requirements for either 1 organism or a population of organisms.
2. Man (always an influence) must be:
 - a. Considered on his proper biological place -
 - b. ~~Be~~ Given no more important role than a grasshopper -
3. Why?
 - a. Present considered as result of a long set of

"Experiments" - evolution -

b. The long-range aspects of evolution have produced organisms with special properties

- 1) adapted to multitude of environmental variables
- 2) represent a fantastic set of gene combinations with, and without regard for our own values.

Therefore:

- 1) Man-environment relationships are not at present measurable by any ^{single} economic yardsticks.
- 2) It is critical to know the ~~value~~ multiple values of plants and animals

other than their direct
effect on usefulness
to man.

Example of problem -
Joule Smith during
discussion -

Examples of pollution from
burning nylon wastes -

I asked why not consider
cotton (though inferior by
many standards) instead
of nylon

Why?

1. A plant, using up
 CO_2 , producing O_2 , organic
substance and a useful
fiber - in man-environment

relativism, I suggest the
total economics to be
balanced in favor of
cotton.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

March 19, 1968

TO: MEMBERS OF THE SEMINAR

FROM: MORRIS E. GARNSEY

Accepting the suggestion made at the last Seminar that several persons present their views of man-environment relationships from the point of view of their respective disciplines, I am asking the following persons to make a brief presentation at the meeting on April 10.

In order to bring out differences in approach the emphasis should be upon the methods and concepts of the disciplines. It is hoped that a consensus or common ground will emerge from comparing the similarities and differences. The invited speakers are:

James Corbridge, Law
 Eugene Haas, Sociology
 Curtis Johnson, Engineering
 A.J. Kelso, Anthropology
 John Marr, Ecology
 → David Rogers, Biology
 R.D. Sloan, Political Science
 Bernard Udis, Economics

I will be grateful if the above persons will acknowledge the invitation. Other members of the Seminar may recall that the date of the next meeting is Wednesday, April 10 at 3:00 p.m. in the University Memorial Center, room 158A.

Summaries of the reports presented by Robert Knecht and Frank W. Smith at the March meeting will be distributed shortly.

David - when can I hear from you?
 m.e.g.

Man-centered universe not in biologist's view - spends time trying to cut himself out of the picture to get an objective view -

Biological materials are not 1-use objects - enter the living cycle at many points
 e.g. cotton → photosynthesis, organic remains, etc.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

March 29, 1968

TO: MEMBERS OF THE SEMINAR
 FROM: MORRIS E. GARNSEY

Here is the proposal for a summer conference along with the letter which has been sent to Mr. Felling of the Ford Foundation. The proposal represents the next step in the work of the Seminar.

We would welcome any comments.

UNIVERSITY OF COLORADO
Boulder, Colorado

Department of Economics

March 29, 1968

Mr. William E. Felling
Program Officer
Resources and Environment
The Ford Foundation
320 East 43rd Street
New York, New York 10017

Dear Mr. Felling:'

Attached to this letter is a preliminary draft of a proposal for a Summer Conference directed toward the creation of a man-environment program in Colorado. We hope to organize a two-week session (June 17-28) of representatives from the University of Colorado, Colorado State University, the University of Denver, and Washington University (St. Louis), for the purpose of discussing:

- (1) the content of a program of research and education in man-environment relationships, and
- (2) the organizational structure of a man-environment consortium of universities and allied agencies in this region.

After the participants in the conference have had sufficient time to report back to their respective institutions we plan to convene a meeting of administrative officers to complete the organization of the consortium, either on July 17-19 or during the following week.

Participants in the conference also will include representatives of appropriate federal and state agencies, particularly those directly concerned with air pollution, water pollution, and other environmental problems.

We have estimated the budget for the proposed conference at about \$21,000. This budget consists primarily of expenses of organization and operation of the conference plus per diem for participants and travel for those some distance from Boulder. It is expected that the participants will be assigned to the conference by their respective institutions on a "released time" basis.

Mr. William E. Felling -2-

March 29, 1968

We would welcome your reaction, and that of Mr. Harrison, to our proposal in advance of submitting it formally to the Foundation. Should you think it worthwhile to discuss the proposal in person we would be glad to arrange a meeting with you at your early convenience.

The proposal for a consortium has been discussed in considerable detail with representatives of Colorado State University and Denver University including the administrative vice presidents. Discussions with Washington University began somewhat later but so far the response has been most cordial.

Sincerely yours,

MEG:chs
enc.

Morris E. Garnsey
Professor of Economics

PRELIMINARY DRAFT

PROPOSAL
for a
PLANNING CONFERENCE
DIRECTED TOWARD ORGANIZATION IN COLORADO
of a
CONSORTIUM
for
RESEARCH AND EDUCATION
in
MAN-ENVIRONMENT RELATIONSHIPS

Submitted by the
Department of Economics
University of Colorado
Boulder, Colorado
Principal Investigator: Dr. Morris E. Garnsey

Introduction

Man's relationships with his physical environment always have been intense, varying in time with his numbers and his knowledge. In his early history man extracted from the environment what he could and adapted to his surroundings to the extent of his ingenuity, while regarding the natural phenomena which he encountered as mysterious and even Godly.

In the Twentieth Century the tremendous increase in population, the rapid increase in the ability to produce and consume due to technology, and the expansion of scientific knowledge - all have greatly altered the previous course of man's relationship with his environment, perhaps in irreversible directions. Population presses in one way or another upon resources. Production and consumption generate such large volumes of "waste" products that the waste also must be regarded as part of a continuous process in which consumable goods hardly can be distinguished from non-consumables. Our sophistication concerning man's relationship with the environment has increased too although at a slower rate. Thus, it now becomes appropriate for us to learn to accept Kenneth Boulding's concept of the "Spaceship Earth" in which man and his planet are seen as irretrievably and inextricably bound together in a closed system of mutual interaction. Parenthetically, it seems uniquely appropriate that a major study of the transition from the "Cowboy" society to the "Spaceman" society should take place in Colorado. (See Boulding, Kenneth, "The Economics of the Coming Spaceship Earth," Chapter 1, Environmental Quality in a Growing Economy, Resources for the Future, Inc., 1966).

The magnitude of man's present and potential ability to modify or control his environment plus the possibility of irreversible alterations in the environment require a new approach to the scientific study of man-environment relationships. Such research and training, as many have recognized, is necessarily inter-disciplinary and involves the cooperation of many scientists in many different institutions. A growing realization of the need for inter-disciplinary research and training has been taking place at the University of Colorado in the last three years. This realization has led to the activities described immediately below and forms the background of the present proposal.

Scholarly Activities at the University of Colorado

After some months of discussion, the interest of a group of faculty members of the University of Colorado in man-environmental problems was crystallized in the organization in February 1967 of a "Conference on the Present and Potential Contribution of the Social Sciences to Research and Policy Formulation in the Quality of the Physical Environment" which was sponsored by the University and the Environmental Science Services Administration. Papers were presented by a group of distinguished persons including Stanley A. Cain, Assistant Secretary of the Interior, Robert M. White, Administrator of ESSA, and Allen Kneese, Director, Water and Environmental Studies, Resources for the Future. A volume of these "Papers" is scheduled for publication in April 1968.

A second result of the Conference was the organization of a Faculty Research Seminar in Man-Environment Relationships which has met regularly during the current academic year. Speakers have included

Kenneth Boulding, Willard Libby and Edward Weidner, Chancellor of the University of Wisconsin-Green Bay. The members of the Seminar also have organized two task forces: one in Education in Environmental Problems, and the other in Priorities in Public Investment in Resources Development. These activities indicate strong interest by faculty members in man-environment relationships.

Influence and Role of ESSA - NCAR

The interest and effect of scholarly activity at the University of Colorado in man-environment relationships has been enhanced by a parallel interest in the scientific community of Boulder. The research laboratories of the Environmental Science Services Administration are located here; and members of the scientific staff of ESSA have participated in the Conference and Seminar including Dr. George Benton, Director, Dr. Gordon Little, Director of the Wave Propagation Laboratory, and Mr. Robert Knecht, Deputy Director of the Research Laboratories. The ESSA laboratories include the Earth Sciences Laboratories, the Atlantic Oceanographic Laboratories, The Atmospheric Sciences Laboratories, and the Institute for Telecommunication Sciences, etc.

We have enjoyed similarly effective collaboration with staff members of the National Center for Atmospheric Research. The scientific staff of NCAR includes meteorologists, astronomers, chemists, physicists, mathematicians, etc. In fact, the Center embodies an inter-disciplinary approach to the diverse and complex processes involved in the behavior of the atmosphere. Regular participants in the Faculty Research Seminar include Dr. Thomas Bilhorn, Head, Program on Applications

Analysis, Dr. William Kellogg, Director of the Laboratory of Atmospheric Sciences, and Dr. Philip Thompson, Associate Director of NCAR.

Need for Organized Research Effort and Graduate Training

Discussion at the 1967 Conference and during the meetings of the Seminar have led to recognition of the need for additional research in many areas of man-environment relationships. Some of these have been discussed at length, others only indicated. While the members of the Seminar recognize that many organizations including university research groups, government laboratories and private institutions are working to achieve a better understanding of man's interaction with his environment, it is felt that the range of problems is so vast and complex that additional research effort is needed. Furthermore, it is apparent that there is a serious shortage of persons interested in this field and moving into it at the beginning of their scientific careers. Consequently, a major function of a university is to provide graduate training in environmental problems and to bring the subject of man-environment relationships into the undergraduate curriculum at appropriate points.

Extra-mural Education

In our discussions the Seminar members also have recognized the importance of extra-mural education in environmental problems. Fortunately, the resources of the Boulder area include the location here of the Thorne Ecological Foundation. This foundation is specialized primarily in education rather than in research. It conducts, among other activities, the Aspen Center for Environmental Studies.

Dr. Bettie Willard, Vice President of the Foundation has been a member of the Faculty Seminar. The participation of the Thorne Ecological Foundation in extra-mural education and publication offers the asset for the proposed Center of a going concern, already experienced in public education in environmental problems.

Possibilities of a Man-Environment Research and Educational Consortium

The bringing together of specialized disciplines as an essential part of man-environment research presents difficulties within an institution as large and diverse as a modern university. Nor is the university the only organization concerned with these problems, vide ESSA, NCAR and the Thorne Ecological Foundation in Boulder. These facts suggest the administrative use of an organization long familiar to the American scientific community - the institute or center. Thus, during the past year various persons at the University have not only engaged in cross-disciplinary discussion, but also have considered the possibility of coordinating research and teaching activities in the man-environment area by some formal administrative organization.

In the fall of 1967 Vice President Thurston E. Manning authorized Dr. Garnsey, Director of the 1967 Conference and the Faculty Seminar, to consider planning for the organization of a formal program of research and educational training in man-environment relations and also to consider the possibility of a consortium of universities directed toward this end. As a result, conversations have been held with faculty members of Colorado State University, Denver University

and Washington University and administrators of the Thorne Ecological Foundation about the possibility of a consortium. Each institution already has presented a preliminary list of areas of competence and specialization. Thus, the groundwork for the summer conference has been laid.

Purposes of the Proposed Summer Conference

The principal objective of the proposed summer program is to develop through intensive discussion and negotiation the agreements and understandings necessary to put into operation a multi-institution man-environment research and education consortium. In attempting to develop the framework for the consortium, we will:

1. Assess the respective relevant strengths and emphases already present among the various cooperating institutions,
2. develop tentative plans for inter-disciplinary, inter-institutional research projects,
3. formulate tentative plans for educational programs to maximize complementarity and minimize duplication, and
4. examine those areas where there is currently little research or educational effort with an eye to developing in the near future strength for a well-rounded program.

An attempt to carry out these purposes does not imply that all of the man-environment interests of each institution would be included in the purview of the consortium nor that there would be an attempt to define the total scope and limits of the problems of man and his environment. The purpose, rather, is to encourage all interested persons and institutions and sub-units thereof to cooperate in the formation of mutually satisfactory working areas.

Organization of the Two-week Study Period

It is planned to invite five representatives from each of the four universities and ten persons from state and federal agencies to meet in Boulder June 17 - 28. The day will be divided into general sessions of small study groups of five or six persons. Discussions will be organized around the topics of the organizational structure and working areas of the proposed consortium. An outline of some of the topics for discussion follows:

I. Inter-institutional Considerations

(Note: "Institutions" as used in this context refers to any and all participating universities, research institutes or centers whether public or private, federal, state and local governmental agencies, not-for-profit foundations and associations and such business enterprises as may be involved.)

A. Receipt and disbursement of "outside" funds for:

1. Research projects
2. Educational programs of all types
3. Administrative activities
4. Publications
5. Service activities

B. Inter-institutional arrangements for students

1. Credit for occasional courses and seminars taken at another university.
2. Integrated degree programs that call for significant blocks of course work to be taken at another university.
3. If B-2 is developed, the problem of minimum residence requirements for various degrees must be solved.
4. Differences in registration and tuition fees among universities.
5. Outstanding exchange students might be "stolen" by the best university.
6. Leave arrangements for non-university personnel to take course work.

- C. Inter-institutional arrangements for faculty and professional staff.
 - 1. The problem of overload commitments.
 - 2. Appointment of non-university professionals to university faculty on intermittent basis.
 - 3. Relation of dual or triple appointments to tenure, retirement contribution, insurance and other fringe benefits.
 - 4. Temporary appointment of faculty to non-university positions.
 - 5. Should professors from another university where the graduate student has taken a significant block of work participate in the Ph.D. examination for the student?
- D. Questions of duplication and complementarity in emphases
 - 1. Areas of emphasis in research
 - 2. Areas of emphasis in educational programs
 - 3. Areas of emphasis in service and publication activities
- E. Central Administrative Unit needed for Consortium as a whole
 - 1. Most appropriate size and type of administrative unit
 - 2. Location of such units
 - 3. If needed, composition and responsibility of a board of advisors or directors

II.

- A. Size and type of administrative unit needed
 - 1. Research projects to be administered by department of Principal Investigator vs. semi-autonomous institute or center to perform the same function.
 - 2. If institute to administer research grants what would its function be in relation to the development and administration of educational programs?
- B. Curricula, majors and degrees granted
- C. Positions for visiting professors and research associates

Organization of the One-week Follow-up Period

The end result of the planning session should be a series of tentative programs for agreement among the particular faculty members from the various universities. These faculty members are then expected to return to their respective institutions and present the opportunity

for organization to the appropriate administrative officials. Approximately two weeks later, on July 17, the administrative officers will meet for a period of 2-5 days to complete the details of organization.

Implementation of the Consortium

At the completion of the proposed program we anticipate putting into operation the consortium based on the agreements and understandings arrived at during the summer. Using the framework developed and agreed upon, the details of the various research efforts for proposed educational programs would be put into effect. Such a continuing effort will involve searching out and recruiting an outstanding person as director, and exploring the various avenues for financing the program.

The above proposal has been discussed with the appropriate vice presidents of the three Colorado institutions: Vice President Thurston E. Manning of the University of Colorado, Vice President A. R. Chamberlain of Colorado State University, and Vice Chancellor Wilbur Miller of the University of Denver, and has received their support and approval. The faculty members themselves are intensely interested and we anticipate no difficulty in selecting participants for the program provided reasonable time is allowed and some flexibility in attendance is permitted.

Conclusion

We have argued that the problems of man-environment relationships are of paramount importance in future decades; that there is interest and competence in the Boulder area in this field; and that it

is desirable to explore the organization of such interest and competence into an effective Center for research and teaching in this field. These possibilities should be explored in depth during the summer of 1968 in the manner described above. The budget for such an effort follows.

Proposed Budget

I. DIRECTION			
Director's Salary (eight weeks)	\$	4,411.04	
Assistant Director's salary		2,500.00	
Secretary		800.00	
Office expenses		<u>190.00</u>	\$ 7,901.04
II. CONFEREES' EXPENSES			
Housing and meals (primarily per diem payments)		6,250.00	
Participants' travel		<u>1,788.50</u>	8,038.50
III. ADMINISTRATION - BUREAU OF CONTINUATION EDUCATION			
		<u>2,264.76</u>	
	\$		18,204.30
IV. INDIRECT COSTS* (15%)			
		<u>2,730.65</u>	
	\$		20,934.95
V. ESTIMATED RELEASED TIME OF PARTICIPANTS			
			(39,000.00)

*NOTE: Normally the University requires 15% overhead for indirect costs. However, this is subject to negotiation if it is contrary to the policies of the Ford Foundation

APPENDIX A

List of Participants in the Faculty Research Seminar in Man-Environment Relationships

Professor Robert Ayre, Chairman, Civil Engineering
Dr. George Benton, Director, Institutes for Environmental Research, ESSA
Dr. Thomas Bilhorn, Head, Program on Applications Analysis, NCAR
Professor Kenneth Boulding, Economics
Professor James Corbridge, School of Law
Professor Ernest Flack, Civil Engineering
Professor Morris Garnsey, Economics
Professor Eugene Haas, Visiting Professor of Sociology
Professor Kenneth Hammond, Psychology
Dr. James Hibbs, Office of Planning and Program Evaluation, ESSA
Professor Curtis Johnson, Chairman, Chemical Engineering
Professor John Ives, Director, Arctic and Alpine Research
Dr. William Kellogg, Director, Laboratory of Atmospheric Science, NCAR
Professor A. J. Kelso, Chairman, Anthropology
Mr. Robert Knecht, Deputy Director, ESSA
Dr. J. P. Kuettner, Director, Advanced Research Project, ESSA
Professor Gottfried Lang, Anthropology
Dr. Gordon Little, Director, Wave Propagation Laboratory, ESSA
Mr. George Lof, Consulting Chemical Engineer
Professor John Marr, Arctic and Alpine Research
Mr. Roger Rhodes, ESSA
Dr. John Rinehart, Director of University Relations, ESSA
Professor David Rogers, Biology
Professor R. D. Sloan, Political Science
Mr. Frank Smith, Program Planning Officer, ESSA
Dr. Philip Thompson, Associate Director, NCAR
Professor Bernard Udis, Director, Bureau of Economic Research
Professor Stanislaw Ulam, Mathematics
Professor Steven Vandenberg, Psychology
Dr. Bettie, Willard, Vice President, Thorne Ecological Foundation

APPENDIX B

The list of participants in the Seminar at Colorado offers a reasonable cross section of persons competent in environmental problems, although the list is by no means comprehensive.

A few of the persons with similar interest at Colorado State University and Denver University are listed below:

Dr. Ralph R. Baker, Professor of Botany, C.S.U.
Dr. Jack E. Cermak, Professor of Civil Engineering, C.S.U.
Dr. A. R. Chamberlain, Executive Vice President, C.S.U.
Dr. Myron L. Corrin, Visiting Professor of Chemical Engineering, C.S.U.
Dr. L. O. Grant, Professor of Atmospheric Sciences, C.S.U.
Dr. Sumner Morrison, Professor of Microbiology, C.S.U.
Dr. C.O. Neidt, Head, Human Factors Laboratory, C.S.U.
Professor Charles H. Prien, Head, Chemical Engineering, D.U.
Dr. Herbert Riehl, Head Atmospheric Sciences, C.S.U.
Dr. John J. Schanz, Industrial Division, Denver Research Institute, D.U.
Professor Charles Stevens, Geography, D.U.
Mrs. Perri Stinson, Research Mathematician, D.U.
Dr. John C. Ward, Professor of Civil Engineering, C.S.U.
Dr. John G. Welles, Industrial Division, Denver Research Institute, D.U.
Professor Gary Widman, School of Law, D.U.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

March 25, 1968

TO: MEMBERS OF THE SEMINAR
FROM: MORRIS E. GARNSEY, CHAIRMAN

Here are the statements of Messrs. Robert Knecht and Frank Smith which were made at the March meeting.

Comments by R. W. Knecht on the two questions - Setting Priorities for public investment in man-environment relationships, and Developing methodology for valuing the natural environment

Introduction - I have attempted to look at questions #5 and #7 not so much from the viewpoint of what the seminar could do in these areas but rather to look at the nature of the questions themselves in hopes that this would perhaps suggest approaches that might be taken.

A task group consisting of Frank Smith and myself was asked to look at the two questions:

- No. 5 - Development of schemes for setting priorities for public investment in improving man-technology-environment relationships.
- No. 7 - Development of methodology for valuing the natural environment (wilderness areas, scenic views, wild rivers, etc.).

First, I would like to examine whether or not these two questions can be brought together into a common framework. With this in mind, we first examine #5 in somewhat more detail.

Analysis of Question #5

The view can be adopted that this question involves primarily the action of the environment on man and his activities. These actions can be of two kinds: (1) the naturally variable part of the environment acting on man (hurricanes, earthquakes, tsunamis, etc.) and (2) man-caused changes to the variable part of the environment acting back on man (air and stream pollution and long-term civilization-caused climatic changes, etc.).

It can be seen that both the matter of the alleviation of environmental hazards and the enhancement of the positive aspects of the environment-man relationship can be included within this framework by proper consideration of the time scales of the phenomena involved. For example, hail suppression involves reduction of a short-term environmental hazard. Similarly, rain enhancement can be thought of as drought suppression, in this case the alleviation of a long-term hazard or imperfection in the man-environment relationship.

It would seem then that question #5 involves the variable part of the environment acting on man in an "other than optimum" manner. Corrective action to improve these interactions would likely be expressed in such terms as moderation, modification, and/or control.

Analysis of Question #7

It is not immediately obvious that question #7 can be fitted within the same framework as question #5. However, it does appear that this can be done if the following approach is taken. It would appear that question #7 basically can be considered to involve man and his activities acting adversely on the environment, in this case on valuable aspects of the natural environment. Viewed in this way, question #7 can be thought of as an additional relationship to be added to the two above: (3) Man-caused change to the (natural) environment.

An implication, of course, is contained in the above statement that the man-caused change to the natural environment adversely acts back on man. Loss of wilderness and natural areas, scenic views, damming the Grand Canyon, etc., would be examples of man-caused change to the natural environment. In this case keys to corrective action to improve the man-environment interaction would be expressed in terms of conservation and preservation.

Hence, the three relationships embodied in questions #5 and 7 can be restated as follows:

- (1) those involving the variable parts of the environment acting adversely on man,
- (2) those where man's activities adversely affect the variable parts of the environment which in turn adversely affect man and his activities, and
- (3) those where man and his activities act adversely on the fixed part of the natural environment, which in turn adversely effects man.

Benefit-cost analysis - It would appear that any methodology for setting priorities for investment or setting values will need to look at benefits and costs for "improving" the various types of interaction listed above. This being the case, where will the major problems lie in attempting to estimate benefits and costs within the above framework?

It appears to me that two of the most difficult aspects will involve the following:

- (1) establishing schemes to estimate the costs of attempting to improve the interactions in (1) and (2) above (it would seem that the benefits are relatively easy to assess in these cases).

- (11) establishment of the benefits in (3) above will also be difficult (in this case, however, costs will be relatively easy to estimate).

I should like to comment on these two points in somewhat more detail below.

Estimating costs

One might look at rain enhancement or rain making as an example of the case at point. Whereas it might be relatively easy to estimate the potential benefits from success in improving this man-environment relationship, it seems to me that estimating the costs to achieve the benefit will be a complicated matter. The typical man-environment interaction might be thought of as evolving through a number of steps which could be expressed as follows: existence, simple use, use with understanding, modification, and, ultimately, control. In order to obtain the ultimate benefits in a rain enhancement program, it would seem the following kinds of activities would have to be undertaken: obtain adequate understanding of the physical processes involved (observation, description, experimentation, etc.); development and test of the necessary technologies; exploration of the associated social and legal problems and development of adequate solutions; and finally exploration and solution of the associated political problems. The total cost of achieving the benefit would have to be determined by estimating the costs involved in achieving the objectives of each of the steps along the way. On the other hand, the benefits to agricultural programs, domestic and municipal water supplies, and so on would be relatively easy, I should think, to estimate.

Determination of benefits

How does one develop a scheme to determine the benefit of preserving fossil beds or a scenic view or the Grand Canyon? How valuable, that is to say, how much money should be spent on the acquisition and preservation of wilderness areas? It seems to me that we must come to grips with this problem in any reasonable approach to questions 5 and 7.

While difficult, I believe that it is not impossible to begin to determine benefits in these cases. For example, one could do studies of the relative drawing power or attraction of scenic areas such as Grand Canyon versus other areas like Death Valley and in this way get some sort of measure of the relative value to the general population of various kinds of natural environmental assets. Also, one could crudely estimate the magnitude of the man-made development that would have to be built to have the same attraction, say, as the Grand Canyon. One could also begin to get a feel for the value placed on wilderness areas by analyzing the distance people travel to use the wilderness area for camping, hiking, etc., and other related factors. Obviously, much work needs to be done in this area before the setting of benefits will be on any sort of a rational basis.

Summary - Summing up then it seems to me that a start might be made on the combined questions of #5 and #7 by taking the following steps:

- (a) attempt to develop a system within which we can describe in more detail the important man-environment interactions, bearing in mind the differentiation between the variable and fixed portions of the environment and the importance of time scale in these considerations,
- (b) develop a scheme for obtaining estimates of the benefits to accrue from improvements of these interactions, especially with regard to the relations given in (1) and (2) above. (In the U.S., for example, on the average 90% of the economic losses comes from adverse interactions with the atmospheric portion of the environment, 9% from adverse interaction between bodies of water (oceans, lakes, rivers), and man, and less than 1% from interactions with the solid earth.),
- (c) look in detail at the steps required to obtain estimates of the benefits from improvement in the above interactions and attempt to develop ways to cost each potential benefit, and,
- (d) finally, look carefully at the question of potential benefits from the conservation of portions of the valuable (fixed) natural environment, encouraging our ecological associates and others to do some hard thinking on the real reasons for preservation and conservation, with a view toward developing a better assessment of the potential benefits.

Comments by Frank W. Smith

My proposal for a Round of Intramural Seminar Presentations

I made the proposition that each member who is willing, be allowed to make a brief statement to the full seminar on the view, from his discipline, of the questions 5 and 7 or upon Knecht's model.

I had offered a re-casting of 5 and 7 to something more tractable. The slogan I used at the last meeting was: "Man's gain vs. nature's loss - effective political choices."

I should think that the seminar could profitably undertake a round of talks, both challenging that slogan and Bob Knecht's model. Any volunteering speaker might be asked to try to address himself thus: "An _____ist's view of the environmental competition and contributions which _____ology can make to the best political decisions."

I would not myself want to prescribe any speaker's range, but I rather liked Frank A. Smith's observation that "we (the seminar's members) don't know what each other knows." The round of talks would be most profitable if, typically, the speaker was trying to reveal his discipline's broad point of view and expected contribution to the solution of man-environment-technology relationship problems, and their resolution.

This memorandum, and one which Bob Knecht is preparing will, I hope, arm you for making a "call" upon seminar members for presentations. We will take this further to aid you if you wish.

QUALITY OF THE ENVIRONMENT

The National Academy of Sciences, National Research Council and the National Academy of Engineering are publishing lists of their committees concerned with various aspects of a particular inter-disciplinary problem. The following list was published in the News Report, February, 1968

Environmental Studies Board - Oversees all environmental quality studies of the NAS, NAE, and NRC. Provides a forum for development and exchange of new ideas and their application to environmental problems.

Committee on Persistent Pesticides - Reviewing the uses of pesticides in relation to the environment, food safety, and human health.

Committee on Resources and Man - Preparing a report on the limits of natural resources and the effect of those limits on the future quality of human life.

U.S. National Committee for the International Biological Program - Coordinating U.S. role in five-year worldwide scientific study of biological productivity and the interrelationships between man and his environment. Among its nine subcommittees are ones dealing with conservation of ecosystems, use and management of biological resources, environmental physiology, and human adaptability.

Agricultural Board - Has for many years been involved in environmental problems. Currently has committees on agriculture and the quality of the environment, physiological effects of environmental factors on animals, plant and animal pests, and remote sensing for agricultural purposes.

Committee on Agricultural Land Use and Wildlife Resources - Preparing a report on the problem of land use in relation to competing values.

Committee on Solid Wastes Management - Studying engineering approaches to solid-waste management problems and appraising various systems concepts for handling junk, trash, garbage, and other solid wastes.

Committee on Air Pollution - Will advise on and emphasize the engineering approaches to air pollution prevention and abatement and undertake specific studies as may be authorized.

Committee on Water Quality Management - Will advise on and emphasize the engineering approaches to water resources management problems and undertake specific related studies as may be authorized.

Committee on Remote Sensing of the Environment - Reviewing the status of sensor technology and its application to study of the environment.

Committee Advisory to the Environmental Science Services Administration - Advises ESSA on its scientific, engineering, and services programs.

Committee for the Development of Criteria for Nonrail Transit Vehicles - Developing design criteria for an improved bus for urban use. Major consideration is being given to reducing air pollutants and noise.

Committee on Environmental Physiology - Studying the physiological responses of man to physical and chemical stresses in the environment.

Committee on Water - Studying ways in which science can improve the management of water resources; now concentrating on the Colorado River Basin to illustrate the principles outlined in first report on alternatives in water management.

Advisory Committee to the Federal Radiation Council - Evaluates the scientific evidence on biological effects of ionizing radiation.

Building Research Advisory Board - Doing several pertinent studies, one of which will compare the present system for collection and disposal of wastes from large apartment buildings in a particular city with an advanced system that would then be introduced.

Committee on SST-Sonic Boom - Examines sonic boom problems and advises on adequacy of research on the production of sonic boom and its effects on people, animals, and structures.

Committee on Ocean Engineering - One part of its assessment of the potential of ocean engineering will deal with pollution of the marine environment by solid, liquid, and gaseous by-products of society.

Committee on Geography - Reviewing the needs of geography as a field of study and research; the work contributes to understanding of the pressures between man and his environment, especially in problems of land use and destruction of resources.

Committee on Toxicology and the Advisory Center on Toxicology - The committee provides advice on problems of toxicology; the center serves the committee as a clearinghouse for storage and exchange of information and evaluations.

Committee on Hazardous Materials - Advises Coast Guard on scientific and technical questions relating to safe maritime transportation of hazardous materials.

Ad hoc Committee on Human Factors in Environmental Change - To explore and identify aspects of pollution for the Environmental Studies Board which the substantive knowledge and methodology of the social and behavioral sciences can help solve.

Committee on Urban Technology and Committee on Social and Behavioral Urban Research - Parallel groups advising on long-term methods for developing and applying both new technologies and social science research to urban problems.

Highway Research Board - Has several committees concerned with the economic, social, and esthetic consequences of highway improvements. Among the current interest of one of such group are beautification, pollution controls, resource development, and esthetics.

Committee on Hearing, Bioacoustics, and Biomechanics - Provides advice on problems such as the effects of noise and vibrations on man, noise levels around airports, and psychological and acoustical effects of sonic boom.

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

EXPRESSION OF INTEREST IN SELECTED AREAS OF MAN-ENVIRONMENT RESEARCH

This questionnaire is designed to assist members of the Seminar in Man-Environment Research in finding out which areas of research are of interest to two or more persons. Such information will provide for the possibility of cooperative research efforts among two or more professionals. Whether or not persons with common research interests actually do collaborate in some manner in the planning and conduct of research is strictly up to them.

The alternatives listed below provide for an expression of your interest in the various research problem areas AND permit you to indicate the extent to which you would be willing to consider working with other professionals on the problem.

Please read alternatives "A" through "H". Indicate your response by writing in the letter of the alternative which best represents your interest and possible collaboration with others in such research.

Additional comments will, of course, be most welcome. Persons indicating an interest in the same topic will be notified.

Please return the completed questionnaire to:

Professor Morris E. Garnsey
Department of Economics
Hellems Annex 239

-
- A. Prefer to work on some aspect of this problem area with research assistants and other sub-professional personnel hired by me. Other senior personnel* would be involved only as consultants if and when I felt their services were needed.
- B. Prefer to work on some aspect of this problem area with one or two other senior personnel where we would take equal responsibility for the development and conduct of the research effort. The other senior personnel might be from my own and/or other disciplines.
- C. Prefer to work on some aspect of this problem area with one or two other senior personnel providing that I serve only as a Co-investigator with someone else serving as Principal Investigator. The other senior personnel might be from my own and/or other disciplines.
- D. Prefer to work on some aspect of this problem area as Principal Investigator. I would be willing to consider an arrangement in which one or two other senior personnel would work with me as Co-investigator(s). The other senior personnel might be from my own and/or other disciplines.
- E. I have some interest in research on some aspect of this problem area but prefer to serve only as an occasional consultant.

* "Senior personnel" refers to persons with faculty rank or persons with similar positions in ESSA or NCAR.

Alternatives -2-

- F. I have some interest in research on some aspect of this problem area but would not have time even to serve as a consultant. I would be willing, however, to try to encourage someone from my discipline to participate in such research.
- G. I have no particular interest in this problem area and, therefore, prefer not to be directly involved.
- H. (Note: If none of the above designations represent your perspective, please write your comments regarding the problem area in the margins at the appropriate place.)

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

Research Possibilities*

Please respond
by appropriate
letter

- _____ 1. Selected Social and Economic Aspects of Tsunami Hazard - A Study in Earthquake Engineering -
The proposal in draft by Haas, Garnsey, Ayre
- _____ 2. Air Pollution, A Case Study of Denver -
Meteorology, economics, public administration and law, social psychology
- _____ 3. Individual Attitudes and Actions in Response to Warnings of Moderate to Severe Storms -
Social psychology, meteorology, economics
- _____ 4. Economic and Legal Problems in the Use of the Radio Spectrum -
Economics, law, aeronomy
- _____ 5. Establishing Priorities for Public Investment (Federal, State and Local) to Improve the Man-Environment-Technology Relationship
- _____ 6. Research on (and answers to) Destructive Winds, Hurricanes, Tornadoes, and Boulder-Type Winds from the Mountains
- _____ 7. Methodology for Valuing the Natural Environment (wild rivers, scenic wonders, wilderness and primitive areas are examples) -
Engineering, ecology, geography, economics
- _____ 8. Study of Re-use of Wastewater of a Municipality by Recycling -
Proposal being prepared by Flack and others
Engineering, medical, economics, sociology, law
- _____ 9. Reappraisal of Water Rights Doctrine from Management Viewpoint -
Law, engineering, political science, economics
- _____ 10. Population control
- _____ 11. Ocean engineering
- _____ 12. Universal Language Adoption and Education
- _____ 13. Validity of Some Computer Methods Developed for Systematic Biology in Certain Social and Economic Problems -
A Feasibility study involving data input from a social problem guided by a sociologist (economist?) working with a team of mathematicians, programmers and biologists.
- _____ 14. Man-Produced Factors in Determining Urban Climate
- _____ 15. A Two-Year Experiment in Conducting Interdisciplinary Student Seminars on Case Studies in the Interaction of Technology and Society: A Research Method

*Arranged in random order

Research possibilities -2-

- _____ 16. What are the Physical Operational Parameters in the Planet -
The Ecological and Housekeeping Rules Which Govern Human Occupancy?
- _____ 17. Can the River Valleys of America's Mountains be Saved from
Destruction by Highway Construction?
- _____ 18. How Do We Educate Persons to Participate in Environmental Sciences
Research, Planning, and Communication with the Public
-

At the present time I am not particularly interested in any of the research problem areas listed above. However, I do have a general interest in man-environment problems and as the year progresses I may want to participate in some way in the development of research of some type in this general area. (Please indicate your response to this statement.)

Yes _____. No, the statement does not represent my view at this time _____.

JAN 8 1968

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

TO: MEMBERS OF THE SEMINAR

FROM: MORRIS E. GARNSEY

Attached are the results of the questionnaire. This will be the topic for discussion at the next meeting of the Seminar on January 17, 1968 at 3:00 p.m. in the University Memorial Center, room 158A

/s/ Morris E. Garnsey

January 8, 1968

Questionnaire

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

Question	A With Research Assistants	B Share Responsi- bility	C Only as Co-Investi- gator	D As Princi- pal Investi- gator	E Only as occasional consultant	F Try to encourage others	G No interest	H Other comments
1. Tsunami Hazard			Ayre	Haas	Knecht Rinehart		9 names	
2. Air Pollution			Little		Corbridge Flack Haas Rhodes Thompson Vandenberg Willard	Ayre Hammond Rinehart	Kelso	Johnson Marr
3. Warnings of Moderate to Severe Storms		Hsiao	Haas		Flack Knecht	Hammond Rhodes	8 names	Marr
4. Economic and Legal Problems in Radio Spectrum			Little Rhodes				11 names	
5. Priorities for public investment	Rhodes	Hsiao	Knecht Smith		Flack Haas Vandenberg Willard	Johnson	7 names	
6. Research on Destructive winds, etc.		Haas			Flack Knecht Thompson	Kelso Rhodes Ayre	7 names	Marr

Questionnaire -2-
Question

	A With Research Assistants	B Share Responsi- bility	C Only as Co-Investi- gator	D As Princi- pal Investi- gator	E Only as occasional consultant	F Try to encourage others	G No interest	H Other comments
7. Methodology for Valuing the Natural Environment		Flack	Ayre Corbridge Willard	Hsiao	Haas Knecht Marr	Johnson Kelso Rhodes	4 names	
8. Re-use of Wastewater by Recycling			Corbridge	Flack	Haas	Johnson Ayre Willard	7 names	
9. Reappraisal of Water Rights		Corbridge Flack				Ayre Haas Johnson Willard	7 names	
10. Population Control		Vandenberg		Hsiao	Kelso Rhodes Willard	Haas Johnson	7 names	
11. Ocean Engi- neering		Johnson				Haas	11 names	
12. Universal Language, etc.					Vandenberg	Haas Johnson	10 names	
13. Computer Methods for Systematic Biology in Social & Econ. Problems		Vandenberg	Haas Kelso		Flack	Johnson	8 names	

Questionnaire -3-

Question	A With Research Assistants	B Share Responsi- bility	C Only as Co-Investi- gator	D As Princi- pal Investi- gator	E Only as occasional consultant	F Try to encourage others	G No interest	H other comments
14. Man-produced Factors in Determining Urban Climate				Flack	Kellogg Little Rhodes Thompson Willard	Haas Johnson Kellogg	5 names	Marr
15. Two-year Ex- periment in Conducting Inter- disciplinary Student Seminars in the Inter- action of Tech- nology & Society		Johnson Vandenberg		Ayre Flack	Haas Kelso Little Marr Rhodes Willard		3 names	
16. What are the Physical and Opera- tional Parameters in the Planet?			Willard		Ayre Corbridge Flack Haas Kellogg Knecht Marr	Johnson	6 names	
17. Can River Valleys & Mountains be saved from Highway Destruc- tion?				Flack	Ayre Corbridge Hammond Marr Willard	Haas Johnson	4 names	
18. How Do We Educate Persons in Environ- mental Science?		Johnson	Haas	Flack	Little Marr Willard	Kelso Rinehart	5 names	

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

PARTICIPANTS

Professor Robert Ayre, Civil Engineering (Chairman)
Dr. Thomas Bilhorn, NCAR*
Professor Kenneth Boulding, Economics
Professor James Corbridge, School of Law
Professor Ernest Flack, Civil Engineering
Professor Morris Garnsey, Economics
Professor Eugene Haas, Visiting Professor of Sociology
Professor Kenneth Hammond, Psychology
Dr. James Hibbs, ESSA, Office of Planning and Program Evaluation*
Professor Curtis Johnson, Chemical Engineering (Chairman)
Professor A.J. Kelso, Anthropology (Chairman)
Professor Godfrey Lang, Anthropology
Dr. Gordon Little, ESSA, Director ITSA
Mr. George Lof, Consulting Chemical Engineer
Professor John Marr, Institute of Arctic and Alpine Research
Mr. Roger Rhodes, ESSA
Professor David Rogers, Biology — Ed. 67/2 #5 + 7 -
Professor R.D. Sloan, Political Science, Asst. Dir. Bureau of Governmental Research
Dr. Philip Thompson, NCAR, (Associate Director)
Professor Bernard Udis, Economics, (Director, Bureau of Economic Research)
Professor Steven Vandenberg, Psychology

Knecht - Essa -

*It is expected that both ESSA and NCAR will designate at least one or two other members.

A PRELIMINARY STUDY OF
SELECTED SOCIAL, ECONOMIC AND ENGINEERING ASPECTS
OF TSUNAMI HAZARD:
A STUDY IN EARTHQUAKE ENGINEERING

J. Eugene Haas
Professor of Sociology

Morris E. Garnsey
Professor of Economics

Robert Ayre
Professor and Chairman
Civil Engineering

University of Colorado
Boulder, Colorado

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INTRODUCTION

There have been repeated suggestions and recommendations in recent years calling for increased research on environmental problems and the hazards to man which are involved. While studies of atmospheric pollution, earthquakes, floods and weather modification clearly have merit in their own right it is the study of the relation of environmental phenomena to man and his works which deserves high priority in research in the immediate future. We have an array of established scientific disciplines which deal with the physical environment and another set of disciplines, the social sciences, which are concerned with the behavior of man and his institutions. There are no established disciplines, however, which deal directly with man-environment interaction and problems. While such disciplines may emerge eventually, man-environment research in the near future will have to be conducted by scientists from the various relevant disciplines working cooperatively on parallel research efforts or, perhaps even better, working together on integrated research projects.

The University of Colorado has decided to take steps toward the development of a multi-disciplinary man-environment research program. One of the first steps has been the instituting of a year-long Interdisciplinary Research Seminar on Man-Environment Problems. Participants represent twelve disciplines and three institutions (University of Colorado, Environmental Science Services Administration Research Institutes, and the National Center for Atmospheric Research).* At the individual level the authors of this proposal have agreed to work together on a combined research effort where the theories and methodologies of three disciplines (civil engineering, economics and sociology) will be applied to the analysis of problems created for coastal communities by tsunamis (seismic sea waves). While there has been rather extensive research on man-environment problems in floods and hurricanes there has been relatively less research on human adaptation to tsunami hazard.

It is anticipated that participation in the Man-Environment Research Seminar will lead to the development of other multi-disciplinary groupings which will result in research on other man-environment problems and issues.

*See Appendix for list of participants.

The need for systematic research on man-environment problems seems clear enough. We are proposing a beginning that goes beyond the talking and committee-report stage, an integrated multi-disciplinary research project dealing with a definable and manageable scientific and social problem¹ - community adaptation to tsunami hazard.

RESEARCH OBJECTIVES

The basic objective of the proposed research effort is to answer the question: What are the major factors determining the way and extent to which communities are prepared to cope with tsunami hazard? Tsunamis are, of course, only one of many kinds of environmental hazard. Knowledge which can be gained through the study of human adaptation to tsunamis will be transferable, at least in part, to man's coping with other environmental hazards such as hurricanes, tornadoes, floods and perhaps even air pollution.

It seems clear that some societies are better prepared than others to cope with certain environmental hazards, e.g., Japan vs. Chile.² Some recent research suggests that communities within the United States also vary considerably in the level of preparedness.³ No systematic effort has yet been made to explain why some communities have rather elaborate technological and organizational arrangements for coping with environmental hazards while others have almost none. To suggest that the citizens of some communities are just more apathetic is hardly an adequate explanation.

If we were to assume that responsible officials and the general citizenry in each community were aware of the threat which tsunamis pose for the community and that the "objective" degree of hazard was the only significant determining factor in community preparedness we would expect to find a high positive correlation between hazard level and level of preparedness. It seems probable, however, that there are a number of factors, including socio-economic ones, which determine the extent to which a community is prepared to deal with an environmental hazard such as seismic sea waves. Until we have a better understanding of what the more significant factors are and how they are interrelated, efforts to increase the level of preparation and thereby reduce injury, loss of life and property damage from tsunamis are likely to prove relatively ineffective.

Effective community adaptation to natural hazard also requires that the engineering and economic aspects of potential modes of adaptation be

examined carefully and recommendations for realistic, feasible and effective modes be developed and made readily available to community officials.

The second major objective of this research effort is to develop such a set of useful recommendations which are based on the findings from careful economic, engineering and sociological analyses of a variety of potential alternative approaches. The knowledge gained in our study of variation in community level of protection will be used as the base for the recommendations which we shall offer.

COMMUNITY LEVEL OF PROTECTION AGAINST TSUNAMI HAZARD

Level of community protection is a complex and multi-faceted notion. The dimensions which must be taken into account include the following:

1. Knowledge of the potential hazard.

- A. Probability of occurrence.

Unlike tornadoes and hurricanes, earthquakes and tsunamis are not seasonal. Further, the occurrence of a tsunami one day apparently does not reduce the probability of another such event three days or three months later for most coastal communities. Since planning and resource commitment are often based on knowledge or belief concerning hazard probability, an understanding of the probability would seem to be important.⁴

- B. Nature of the threat.

1. Range of severity which the threat poses.

Depending on the local topography and land use a tsunami may have the potential for only minor or for very severe consequences. Knowledge of the potential level of severity is, of course, important for plans to meet the threat.

2. Type of threat.

Is the community likely to be faced with a "wall of water," gentle swells or only slight increases in water level?⁵ Is it likely to produce secondary hazards such as fires?

3. Speed of onset.

What is the time span likely to be between the first significant change in water height and movement and the point of full impact?

4. Length of danger period.

What do officials know about the length of time during which the danger continues to exist? Initial evacuation is only part of the problem; staying out of the risk areas until danger is past is the other part.

2. Receipt of warning at community level.

A. Technological aspects of communication systems.

Is there a "fail safe" arrangement for receipt of warning messages? Are there established alternative modes of communication so that the messages will be received if the primary mode is rendered inoperative for any reason?

B. Human and organizational arrangements for receipt of messages.

Messages may be "received" via teletype or some other mode but unless there is a competent person on hand 24 hours a day every day of the week to recognize the nature and potential urgency of a warning message the warning process has, in fact, been short circuited.⁶ Similarly, unless there is a foolproof organizational arrangement to insure that the message will be given to those persons responsible for dissemination of the information to the appropriate agencies and the public, the "received" message is of little value.

C. Interpretation of message and decision to warn population.

Available evidence suggests that the meaning of a warning message is not always self-evident.⁷ Knowledge of technical vocabulary and past experience with warning messages are just two of the factors which may influence the interpretation made by the recipients, and, hence, the decision made on whether or not to take appropriate action.

Clearly, the "successful" receipt of a warning message involves technical, human and organizational considerations.

3. Dissemination of warning messages within the community.

A. Number, type and effectiveness of alternative technological modes.

When a tsunami warning message is received at one or more points in a community and the decision is made to inform those persons in the danger area of the impending hazard there are a variety of technical means which may be used. It is not entirely clear which mode is the most effective, but

it is reasonable to assume that multiple modes are going to be more effective than reliance on a single mode.

An obvious procedure is to have the "receiving office" use telephone to notify the local radio and television stations and request that the warning message be broadcast repeatedly. This approach has a number of potential problems, both technical and social. During late evening and early morning hours the stations may not be broadcasting. Even if arrangements are made in advance for one or more stations to come back "on the air" for the dissemination of such a message there is no assurance that those who need to hear the message will be awake or, if awake, will know or remember that the station is probably broadcasting at the unusual time of day. Regardless of time of day, even for those listening there is the possibility that their receivers may be tuned to non-local broadcast stations which may not be a part of the warning network.

Other warning procedures which might be used include the sounding of stationary sirens distributed throughout the appropriate areas and the movement of police and fire department vehicles through the risk zones with sirens sounding and red lights flashing.

This brief discussion of procedures for the dissemination of warning messages was presented to illustrate that this part of the warning process is more complex than it is often assumed to be. A simple "check list" approach to estimating level of preparedness in this matter will not be satisfactory. A careful examination of all the procedures used and their level of effectiveness is required.

B. Interpretation of warning messages and signals.

Any protective action taken by those whose lives and property are in danger is dependent in part on their interpretation of messages and signals which they hear. A community in which most of the population have a clear understanding of the intended meaning of various signals emitted by sirens and know what protective action should be taken is certainly better prepared than a community where only a minority of the residents have such knowledge. In those communities which utilize sirens for warning purposes we will need to conduct areal sampling in the risk zones and interview residents to ascertain the extent to which residents interpret correctly the meaning of the signals and the knowledge which they have about protective action to be taken.

4. Organization for evacuation.

A. Evacuation of the population.

The better prepared community will have some established procedures to insure that all persons leave the danger area when that is necessary.⁸ Children unattended by responsible adults and all persons who are immobile due to illness or disability are especially vulnerable in such a situation. Plans for traffic flow out of the area and procedures for cordoning off the danger area so that sightseers cannot enter are also important.

B. Removal of valuables.

Since tsunami warning messages may be received several hours in advance of the first water action there is often sufficient time to remove valuable items such as records, currency and vehicles to safe locations provided that appropriate plans are made and rehearsed in advance. A telephone "fan out" procedure utilized during the "tsunami watch" period prior to the general evacuation can provide businessmen with an opportunity to move valuable items.

C. Care of evacuees.

Residents in risk zones will be less reluctant to evacuate if they know that they will have a reasonably comfortable place to remain during the several hours which must elapse before the potential danger is past.

5. Control of the potential water action.

Preparation for receipt and dissemination of warning messages and evacuation procedures would be unnecessary, of course, if the danger from tsunamis were in fact negated by the construction of sea walls or other similar devices. Such a defense, if effective, would be the ultimate in preparation.

But this approach may be unacceptable to the community for economic and/or esthetic reasons. Where it is unacceptable there are two other general types of coping with the hazard which can minimize the potential destruction and loss of life: control of land use and construction of tsunami resistant buildings.

6. Land use controls.

To the extent that historical records of water runoff heights from past tsunamis are available it should be possible in most communities to delineate those areas which are susceptible to inundation from tsunamis and those which are safe.⁹ In some very small communities with low elevations strung out along the coast it is conceivable that the entire town could be within the risk zone. Land use controls, if rigidly applied, might require moving the entire town to another location as in the case of Valdez, Alaska.¹⁰ However, for most towns and cities significant property loss, and to a certain extent loss of life, could be averted by the development and enforcement of land use controls which prohibit the placement of buildings on land in designated risk zones. If the land in the risk area is kept free of major streets and highways, then the community is protected to a very significant degree from potential loss simply by "staying away" from the hazard. Communities which have instituted such a policy represent a level of preparedness beyond those which have not.

Many communities have not and probably will not follow such a policy because the land is considered to be too valuable and/or the area has already been built up to the point where the costs involved in abandoning or demolishing the structures are considered prohibitive when contrasted to the potential losses from tsunamis.

However, the instituting of such land use controls for unimproved land in risk areas immediately adjacent to already developed areas may be another matter. Here the application of controls prohibiting the construction of buildings would provide protection against damage and loss of life which would otherwise occur at some time in the future. At the immediate point in time when such land use policy is adopted the level of preparedness is not significantly improved but with each passing week the level, in fact, goes up as new buildings are constructed outside the risk zone rather than within it. It is comparable to a policy which requires that all new schools must be built away from hazardous installations such as petroleum tank storage facilities and chemical plants.

But even where tsunami relevant land use controls are not in effect, or where they apply to only certain types of structures such as prohibition of buildings designed for high density occupancy, a building

code which requires tsunami resistant construction may still provide a considerable degree of protection against some types of damage and loss of life.

7. Building codes requiring tsunami resistant construction.

While it is conceivable that a community might adopt building code regulations which would require owners of structures already in the danger zone to renovate their buildings so that they would meet the standards for tsunami resistant structures, this is likely to be a rare event. Where such a policy has been in effect for some time a significant proportion of the structures in the danger zone should be able to resist the forces produced by a tsunami when it occurs. The higher the proportion of such structures the greater is the level of protection.

This statement assumes that enough is known about the forces produced by a tsunami so that meaningful and reasonable building code requirements can be stipulated. It is by no means clear that the "state of the art" has arrived to this point.¹¹ Careful examination of this matter by specialists in the relevant disciplines is required.

Too, the issue involves more than the engineering and design considerations. Economic and sociological aspects are probably just as important. A strict building code which is not enforced, or only partially enforced, due to economic, political or social considerations will be likely to produce a false sense of security with the consequence that other modes of preparation, such as a warning and evacuation system, may be neglected.

Summary

We have suggested that societies and communities vary in the extent to which they are faced with significant environmental hazards. Even coastal communities differ in the degree to which they are susceptible to damage and loss of life from tsunamis. Some have a high degree of "natural" protection as the result of off-shore islands or a peninsula, favorable underwater topography, or because the city is located on a bluff high above water level. Others have little or no such protection, and, therefore, any protection which exists must be created by man. It is thus a matter of technology, economics and sociology.

We call this variable adjustment to potential tsunami hazard level of protection. Available evidence suggests that communities vary in the ways and extent to which they are prepared to cope with this hazard.

We have indicated that assessment of the level of protection for any community requires examination of a number of interrelated factors each of which may make some contribution to that level.

With regard to Level of Protection (LOP) we shall attempt to:

A. Develop a weighted index of community LOP so that at a minimum we can rank the communities in the sample from highest to lowest. Professor Haas will take the major responsibility for this aspect.

B. Develop a useful mode of cost-benefit analysis for local warning systems, land use controls and building code requirements and enforcement. Professor Garnsey will direct the cost-benefit analysis.

C. Develop a set of standards for building code requirements to meet the tsunami problem which reflect the current "state of the art" in structural design and which have reasonably good prospects for implementation at the local level. This aspect of the research will be directed by Professor Ayre.

These three interrelated tasks can best be accomplished by utilizing the intensive case study approach initially. We shall select a number of communities in Hawaii, Japan, Canada and Chile where the tsunami problem has been most persistent in recent years. In these communities we should be able to see the widest range of technological adaptations, organizational mechanisms and actual costs and benefits involved. Further, it should provide the best available data of the demonstrated effectiveness of the various approaches used.¹²

These case studies will permit the researchers to develop and further refine the analytical approaches and techniques which will be used later in the study of the larger sample of communities discussed in the next section of this proposal.

EXPLANATION OF VARIATION IN COMMUNITY LEVEL OF PROTECTION

Since this is a limited and exploratory study we cannot hope to examine all possible factors which determine and influence the level of protection in a community. We will attempt, however, to carefully study those variables which appear to be reasonably important across many communities and which appear to be measurable or at least amenable to careful assessment.

Listed below are the major independent variables which we intend to examine. We want to ascertain the extent to which "objective" vulnerability

to tsunami hazard is associated with the community level of protection (LOP). Also we will examine the significance of disaster proneness (frequency of natural disasters of all types), size of community and level of economic affluence for the community LOP. Ideally, the researcher would select a large sample of perhaps 200 coastal communities, gather data on all of the variables and then test each variable singly by statistical control so that all but one of the independent variables would be held constant in each test. For example, in analysis we would examine the significance of "objective" level of vulnerability by pulling out of the larger sample all those communities which are low on disaster proneness, small in population size and economically less affluent to see whether being low vs. high on vulnerability makes a difference in LOP. Unfortunately the costs involved in gathering data from 200 or more communities makes such an approach impractical at this time.

As an alternative we plan to utilize a Greco-Latin square design where we will select for study only those communities which have the desired combination of pre-designated characteristics. By treating four independent variables as dichotomies the following sixteen combinations of characteristics emerge.

DEGREE OF "OBJECTIVE" VULNERABILITY
TO TSUNAMI HAZARD

<u>Moderate or Low</u>	<u>High</u>
(1) Disaster Proneness - Low Size - Small Economic Affluence - Low	(2) Disaster Proneness - Low Size - Small Economic Affluence - Low
(3) Disaster Proneness - High Size - Small Economic Affluence - Low	(4) Disaster Proneness - High Size - Small Economic Affluence - Low
(5) Disaster Proneness - Low Size - Large Economic Affluence - Low	(6) Disaster Proneness - Low Size - Large Economic Affluence - Low
(7) Disaster Proneness - High Size - Large Economic Affluence - Low	(8) Disaster Proneness - High Size - Large Economic Affluence - Low
(9) Disaster Proneness - Low Size - Small Economic Affluence - High	(10) Disaster Proneness - Low Size - Small Economic Affluence - High

- (11) Disaster Proneness - High
Size - Small
Economic Affluence - High
- (13) Disaster Proneness - Low
Size - Large
Economic Affluence - High
- (15) Disaster Proneness - High
Size - Large
Economic Affluence - High

- (12) Disaster Proneness - High
Size - Small
Economic Affluence - High
- (14) Disaster Proneness - Low
Size - Large
Economic Affluence - High
- (16) Disaster Proneness - High
Size - Large
Economic Affluence - High

The plan is to utilize the four dichotomous variables in the selection of communities so that we will have at least one community in each of the sixteen cells. While it would be highly desirable to have many cases for each cell, the costs involved will undoubtedly keep the number of cases in each cell below five. This design, however, does permit the maximum number of controlled tests for the research dollars invested. Once the communities are selected and assigned to the appropriate cells we will gather the data necessary to estimate the level of protection which each community has developed. This will permit analysis which should provide the basis for answering the question: Which combination of variables tends to be most consistently associated with high as contrasted to low level of protection? As will be indicated below we also want to take an exploratory look at a number of other variables which might be related to LOP in some systematic fashion.

At this point we shall briefly discuss our tentative conceptualization of the various explanatory variables to be considered.

Major Independent Variables

Degree of "objective" vulnerability

Reasonably accurate forecasting of earthquakes and resulting tsunamis is still a long way from reality.¹³ However, we can start with the observation that when tsunamis have been generated at various points on the Pacific Ocean rim some communities have been impacted more frequently than others and of those struck, the wave heights and water run up heights have been greater for some than for others. Therefore, we may say that when tsunamis are generated some communities have a higher degree of "objective" vulnerability than others. Utilizing records of tsunami action, we should be able to roughly categorize communities into those with relatively high

vulnerability as contrasted to those with relatively low or moderate vulnerability.

We use the term "objective" to refer to the water action as it does or would occur unimpeded by any man made protective efforts such as sea walls, land use controls, warning systems, etc. We shall consult with Professor Doak Cox and personnel of the Joint Tsunami Research Effort (University of Hawaii, HIG and ESSA), Professor R.L. Wiegel, University of California, Berkeley, Mr. Robert Eppley, Coordinator of the Tsunami Warning System, U.S. Coast and Geodetic Survey, and other specialists who have expert knowledge about tsunamis and tsunami records.

It is possible that some communities may have both a high degree of objective vulnerability and have also instituted a high level of protection so that when a tsunami occurs the consequent damage is very slight. It is even conceivable that a community may have a relatively low degree of objective vulnerability and still have an unusually high level of protection, perhaps even more than is "needed." In any event, we want to find out the relationship, if any, between degree of vulnerability and level of protection, and, therefore, the two phenomena must be kept conceptually distinct.

Disaster proneness

Disaster proneness as used in this research effort will refer to the frequency of occurrence of all types of natural hazards other than tsunamis. Moore and others¹⁴ have suggested that communities which are subject to high frequencies of natural disaster will develop a "disaster sub-culture." Such a sub-culture may take the form of general apathy among the population, or at the other extreme there may be the development of an elaborate set of technological and organizational mechanisms to cope with the repeated hazards. We are hypothesizing that the frequency of natural hazards of all types will produce some distinguishable type of general community response and that this response will also be reflected in level of protection against tsunamis. More specifically, we would hypothesize that a community that has a relatively high frequency of floods, destructive winds, blizzards, etc. will have developed a higher than average level of protection against such hazards and will also have developed a higher than average level of protection against tsunami hazard.

Again, we must be careful to distinguish between the frequency of these other hazards per se and these hazards as they are actually experienced. A town may be subject to repeated instances of abnormally high rainfall amounts (high flood hazard), but if a series of flood control dams and levees has been developed it may seldom experience flood damage. In such a case the town would have to be rated high on flood disaster proneness even though damage is infrequent, the low degree of damage being attributed to the success of the coping mechanisms which have been instituted.

Size of population in community

We want to ascertain what relation size of community has to level of protection. There may be a critical point in size below which LOP is consistently low. Correlative considerations to be examined include the number of persons and the proportion of the community population residing and/or working in the tsunami hazard zones of the city.

Economic considerations

There are several important economic problems involved in the tsunami hazard. In the most general terms protection against this natural hazard may be approached as a problem in Cost-Benefit Analysis. The costs would include expenditures for protection against the hazard, ranging from the construction of sea walls and hazard-resistant buildings, to the warning systems and forecasts. The "benefits" may be defined as the avoidance, by proper protection, of losses of property and life, the disruption of normal economic activity, and the rehabilitation of private and public property which has been damaged or destroyed. Looked at in this way, the economic problems may be attacked through the adaptation of conventional methods of Cost-Benefit measurement (such as those employed by the U.S. Army Corps of Engineers for flood control) to the tsunami hazard. It is anticipated that the adaptations may be extensive.

Second, in going beyond the conventional Cost-Benefit approach in the analysis of the economic consequences of tsunamis, an immediate consideration is the proper calculation of the risk factor. This factor will vary with the size and wealth of different communities and with differences in per-capita income, thus requiring an analysis of the economy of each community to be studied. Risk also will vary with the extent of and reliability of protective measures, including not only sea walls and structures, but also warning systems, evacuation plans and emergency measures.

Third, it is proposed to incorporate in our analysis the latest developments in the field of Criteria for public investment.¹⁵

Fourth, the incidence of the cost of protection also will be studied with reference to the optimum division of costs between the public and private sectors. The division of cost among the central government (in the United States, the Army Corps of Engineers and the Office of Civil Defense) or state and provincial governments, or local governments, or the inhabitants of the hazard area itself will be studied. The question of the degree to which user fees can be levied also will be studied in the context of the demand for collective goods. For example, Burton Weisbrod¹⁶ advances the relatively new concept of option demand as a factor in the pricing of collective goods. It is proposed to examine the applicability of this concept to the individual's attitude toward bearing the cost of protection against tsunamis.

It is quite clear that economic analysis of the kind proposed here will require interdisciplinary cooperation. The problem of protection against the tsunami hazard is, in many respects, an engineering problem. The engineer must determine the nature of protective structures and also the type of construction of buildings which would be resistant to the hazard. The determination of the division of cost between private individuals and public agencies is not only an economic problem but also one involving the political structures, the efficiency of public administration and the sociological aspects of group behavior. Consequently, collaboration with the relevant disciplines is essential to reliable estimations of the economic impact of tsunamis.

Other Independent Variables

With small sample size it is not possible to control for very many variables. However, since there are a number of other variables which should be considered we shall collect data on some additional factors in an effort to get some preliminary indication regarding their significance for community LOP. Those to be considered will include but will not be limited to the following:

1. Perception of community vulnerability to tsunamis by local officials

Perception of vulnerability is not necessarily correlated highly with objective vulnerability. Fritz and Marks,¹⁷ Withey,¹⁸ and Drabek¹⁹ have pointed to the tendency of persons to interpret disaster cues in normal

terms so as to continue to define the situation as not threatening. If officials perceive the hazard to be insignificant, that perspective will probably preclude any systematic planning for improvement in LOP and may also lead to a gradual degrading of the organization and technology which may have been instituted in previous years to cope with tsunami hazard. More "realistic" perceptions may be a necessary but not sufficient condition for the existence of moderate to high LOP for the community.

Persons whose official responsibilities may fall in this area include mayor, city manager, members of city council, planning commissions, and zoning boards and heads of public works, building, police and fire departments. An appropriate attitude scale will be developed to measure tsunami hazards perception.²⁰

2. Patterns of land use in water run up zones

Most communities will probably not have officially designated risk zones, and hence we refer to water run up zones as those low lying areas which according to the records are very likely to be inundated when a tsunami strikes. We want to ascertain whether the community LOP is related in any way to the predominant type of land use in the risk zones. Is the LOP consistently higher or lower if the risk zone area is used principally for industrial and commercial establishments as compared to residential use? If type of land use per se is not significant, it may be that the tax valuation on properties in the risk zone may be related to LOP.

3. Availability of disaster - relevant resources

A common occurrence following a natural disaster in the United States and in many foreign countries is the movement of massive amounts of material and personnel resources into the stricken community from nearby military installations.²¹ The immediate proximity of such resources may contribute to a "if we ever have a disaster the military will provide all the help we need" attitude on the part of both officials and citizens. Most local officials will also be aware of the fact that such assistance is usually provided at little or no direct cost to the community, and hence the potential for a strong dependency relationship exists. We will attempt to ascertain the extent to which such a view is held by local officials and whether or not it appears to be related to community LOP.

Interviewing with the use of open-ended and indirect questions will probably be the most effective technique to use in this part of the data collection phase.

4. Availability of technical knowledge regarding tsunami hazard and appropriate counter measures

There is some research evidence which suggests that improvement in LOP following a tsunami disaster may be dependent in part on the ready availability of technical knowledge from experts who reside in or near the stricken area.²² This may be especially true for smaller cities which often have a limited range of professionals and technical specialists. The presence of a university or other similar facility in or near the community provides a special kind of resource which may not be readily available otherwise. Whether or not the available technical knowledge is utilized and therefore reflected in the LOP may be determined by a variety of other factors but we would hypothesize that the city which has no such ready access to the relevant technical knowledge is less likely to have a high LOP than one which has such access.

SCHEDULE OF RESEARCH EFFORT

We propose a three-year research program to begin on March 1, 1968 or as soon thereafter as possible.

I. First Year, first six months:

- A. Select and train field research staff.
- B. Conduct detailed case studies in Hawaii, Japan, Canada and Chile.
- C. Begin collection of data to be used for selection of communities to be included in the sample.
- D. Develop initial list of parameters to be used for Cost-Benefit Analyses.
- E. Examine available information on relevant protective structures and structural design considerations.
- F. Begin development of community Level of Protection Index.

II. First Year, second six months:

- A. Complete data collection for selection of communities in sample, review alternatives and make final specification of the sample.
- B. Refine Cost-Benefit Analysis procedures.

- C. Develop field procedure to be used for engineering aspects.
- D. Refine conceptualization and field procedure to be used in application of community Level of Protection Index.
- E. Pre-test and revise all interview schedules, questionnaires and attitude scales.
- F. Begin detailed analysis of information from intensive case studies.

III. Second Year:

- A. Begin data collection from communities in sample.
- B. Complete detailed analysis of information from intensive case studies.

IV. Third Year:

- A. Complete data collection.
- B. Analyze and interpret findings.
- C. Prepare recommendations for improvement of various aspects of community level of protection.
- D. Prepare and distribute reports and publications.

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*Fill in Gounsey
Seminar*

ENVIRONMENTAL QUALITY CONTROL:

A STATEMENT OF THE PROBLEM

Douglas L. Brooks

American Institute of Biological Sciences

Plenary Session

August 28, 1967

THE TRAVELERS RESEARCH CENTER, INC.

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ENVIRONMENTAL QUALITY CONTROL: A STATEMENT OF THE PROBLEM

INTRODUCTION

It wasn't too long ago, in terms of history, that Mark Twain was able to get an appreciative laugh by observing how everybody complains about the weather but nobody does anything about it. Nobody laughs anymore. Not because the joke has become a cliché; all successful jokes do. But because we are beginning to see that what's happening to our environment--the weather included--has turned out to be a joke on us. Absurd perhaps, but not funny.

Is it not absurd that in the midst of the greatest material development the world has ever seen--and in a very real sense, because of it--the American people have ever-increasing cause to complain--not merely about the weather, but about virtually every aspect of their environment? And is it not utterly serious when scientists and government leaders such as those assembled here are being flooded with exhortations from every quarter--to do something about it and to do it soon?

Some would have us "preserve" the environment, implying that the thing we need do is arrest further change. Some would have us "restore" it out of a perhaps nostalgic belief in the existence of some hypothetical optimum "natural" state that prevailed before the noticeable impact of man. Others would "improve" it--by extending the coastline through massive engineering efforts, for example, to create artificial lagoons, estuaries, and islands; or by converting Long Island Sound into a fresh water reservoir; or by modifying normal rainfall amounts and locations by cloud seeding.

Athelstan Spilhaus has named this kind of activity "geotechnology." He defines it as "the emerging field through which we shall use our geophysical knowledge to intervene and change natural processes on a large scale, hopefully for the benefit of mankind" [1]. I wonder if you are struck, as I am, by the rather wistful use of the word "hopefully" in this quotation. Mark Twain would have appreciated its poignant

literary possibilities and the opportunity for sharp-edged irony it might have afforded him.

Yet this is not a time for either irony or poignancy or cynicism or despair. On the contrary, a pattern of thinking that I regard as extremely hopeful is beginning to emerge in scientific and government circles. This thinking proceeds from the fundamental assumption that the phenomenon of environmental deterioration is not merely a transcendently challenging subject for scientific study and understanding, though it certainly is this. More important and encouraging, this thinking accepts environmental deterioration as an urgent and challenging problem for systematic management and control.

Reflecting this emerging willingness of the scientific community to deal with urgent real-world problems, to which the solutions will always be less than ideal, but one hopes (not at all wistfully) livable, this AIBS Plenary Session of three related papers is cast in a management framework, not a purely scientific one. We will, in other words, be talking about environmental management, not just environmental science. To me this means, first- and most exciting—the need for an unprecedented collaboration or partnership among many fields of science, the life sciences represented here, the physical sciences from whose tradition Dr. Cassidy and I come, and the social sciences. In a sense, we must all become social scientists. Further, it means that such cross-disciplinary studies must be done in an action framework, with prescription—not just description—as their goal.

Having set the stage with these general remarks, let me proceed quickly to the specific task which brought me here. My assignment is to help structure this still amorphous cross-disciplinary field of environmental management by describing one of two related categories of phenomena into which environmental changes can usefully be divided for management purposes. The category that is my concern consists of those generally small or gradual changes whose individual and immediate effect on the environment is hardly noticeable, but whose cumulative and ultimately pervasive nature is eventually perceived as a drastic decline in environmental quality. The other category consists of more suddenly dramatic and immediately threatening changes in the environment and is the subject of the second paper this morning.

A suitably pejorative term for describing the gradual changes which are my concern is "environmental decay." The corresponding management problem is "environmental quality control." In addition to describing the phenomenon of environmental decay, I shall try to sketch the outlines of a promising approach to its control.

ENVIRONMENTAL DECAY

Views of what we mean by the complex term "environment" vary from person to person, group to group, and time to time, as do preferences regarding the meaning of quality control and methods for achieving it. A number of articulate and thoughtful spokesmen, however, have converged to a remarkable degree in books, reports, and articles that have appeared through the last dozen years on a description of the main features of environmental decay. The similarity of their viewpoints is sufficient to permit me to offer what now appears to be a culturally consistent and stable view of what is meant by this term [2-8].

The various kinds of environmental decay that emerge from this apparent consensus can be described under five main headings:

First is the decay represented by the impoverishment of our resources. Two kinds of resources are involved here: Essential resources such as food, minerals, water and living space; and desirable resources such as wildlife, play space, walking space. (Parenthetically I might add that I realize fully that one man's desirable resource is another man's essential one.) On a global scale, mass starvation as burgeoning populations overwhelm the already inadequate food supply is the most compelling problem resulting from resource inadequacy. But even within the food-surplus U.S., our critical dependence on minerals and other natural resources from parts of the world where mounting food shortages threaten political and economic institutions makes their food problem ours. And, finally, our ability to utilize the impoverished and increasingly inaccessible raw materials needed by our industrial civilization is dependent on increasingly sophisticated extraction and processing technology. Destroy that, as nuclear war, for example, would inevitably do not only here but inevitably around the world, and industrial society could probably never again get started.

A second kind of decay is represented by the increasing levels of pollution, noise, and ugliness within which we are being immersed. The evidence here is too well known to need elaboration.

A third involves increasing crowding, congestion, and hence conflict over incompatible uses of the environment. Let me mention only one, the competition for space between men and their cars. "Either one of these exploding phenomena can smother the continent. 'Already,' comments Edward C. Crafts of the Bureau of Outdoor Recreation, 'automobiles occupy more space in America than do people.' 'For the next decade the American scene that will experience a population growth of 58 million will shudder under a disproportionate avalanche of 50 million space-consuming cars. A four-lane highway consumes up to fifty acres of land per mile, preferably the most level and strategically located land.' Underlining this, Joseph J. Shomon in AUDUBON MAGAZINE writes, 'Everywhere the battle for open space is bitter, the competition mounting. The most profitable uses—however unsightly, ill-considered, or shortsighted—have been crowding out less lucrative but more aesthetic uses. A new highway, a new facility, a new development, each tends to go where resistance is weakest, and this is usually an existing park or some unspoiled open space. Atlanta has cannibalized more than 60 percent of its park land. Over cries of outrage the historic Morningside Park in Manhattan is giving way to a school.'" [7]

The fourth variety of environmental decay manifests itself in the increasing depersonalization or "thingification" of life, due to growth in size, complexity, and ubiquity of cities, traffic, and mass communications media.

Fifth, and finally, there is the environmental decay of potentially Wagnerian proportions, in which inadvertent and perhaps irreversible modification of the earth's weather and climate caused by man's activities could make all the other kinds of decay of only academic concern. The production of carbon dioxide by world wide burning of fossil fuels promises, according to some, to so increase the "greenhouse effect" of the heat absorbing constituents of the atmosphere that a world-wide climatic warming may take place, perhaps melting the Antarctic and Greenland ice-caps and raising the sea-level by a couple of hundred feet. Whether this will be in part

counterbalanced or perhaps overbalanced by the solar radiation-reflecting effect of the increased cloudiness expected from air pollution is a moot question, as is the possible rainfall-inhibiting effect of pollution nuclei in producing clouds containing overly large numbers of abnormally small droplets which remain stably suspended in the air rather than coalescing to produce precipitation [3]. In any case, weather and climate changes of a possibly drastic nature appear to be in the making.

THE ENVIRONMENT-MAN SYSTEM

One way to begin the job of environmental quality control is by identifying the properties common to all kinds of environmental decay. I am struck by six particularly. They are:

(1) The changes, though accelerating, are slow and must be viewed over the perspective of the years and decades ahead for their full import to be seen.

(2) The immediate causes of these changes are myriad.

(3) Interactions among changes in the environment are numerous and complex; they involve nature as well as man, his instrumentalities, his artifacts.

(4) More remote, let alone ultimate, cause of environmental decay are unclear. As scientists, for example, are we to accept population growth and industrial productivity as the ultimate causes of our troubles, or can these in turn be merely by-products of some more fundamental and perhaps unmanageable drive in mankind?

(5) Our understanding of the over-all problem is at best partial, and our knowledge is full of gaps.

(6) There is no simple "magic bullet" solution, though there are many partial solutions being ardently advocated with only dim recognition of their interdependence.

Identification of these six properties common to all kinds of environmental decay sets us on the road to finding an answer to the question "What's to be done?"—in that it at least shows us the dimensions of our ignorance. How do we diminish this

ignorance even as we take the all-important first steps to doing something?

I think we can take this first step as well as subsequent ones with some assurance of eventual success if we look at man and his environment as interacting components of a single closed system of global proportions. Marston Bates has called this system the human ecosystem; and Kenneth Boulding has provided a vivid metaphor for it by referring to it as Spaceship Earth. It consists, on the one hand, of the subsystem "man" and some portion of his attitudes, habits, values, and the institutions by which he functions—the family, welfare and educational institutions, corporations, governments, and the like. And it consists, on the other hand, of the subsystem "environment"—the physical context in which man and society exists. The physical environment itself is comprised of two interacting components: One is natural—geography, weather, climate, minerals, wildlife, etc.; the other, the increasingly important one, is artificial—a man-made complex of cities, highways, traffic, and mass communications.

BASIS FOR A SYSTEMS ANALYSIS

To pursue this systems approach to managing the environment, we need to be able to do the following three things:

- (1) Specify the variables representing man's inputs to the environment (They will be related somehow to population and industrial productivity.),
- (2) Specify the variables representing the environment's outputs of major concern to man (I have suggested five such, ranging from resource exhaustion to inadvertent weather modification.),
- (3) Develop a quantitative model of the environment showing how the outputs are related to the inputs and to each other (Even a first crude approximation would be a tremendous asset to thinking and planning as well as to research.).

Then, turning to man in his limited and partial aspect as an environmental management subsystem, we need to begin with the environmental outputs and do the following:

- (1) Identify the problems they create for man in terms of his goals and objectives,
- (2) Identify alternative environments (or groupings of related and compatible environments) to be considered as potential solutions to these problems,
- (3) Develop a framework for comparing and criteria for ranking these alternative environments and environmental sets and for compromising conflicting goals and objectives,
- (4) Evaluate alternatives and present plans for pursuing them to decision-makers and to the public in a fashion that is understandable and useful.

Finally, decision-makers themselves need to acquire the tools needed to monitor environmental outputs and to activate the requisite corrective inputs in the light of the above. I will pursue this no further, since Professor Cassidy will develop this control aspect of the problem in more detail.

PRECEDENTS AND PROSPECTS

Is there any hope that this approach can in fact be usefully adapted to environmental quality control—where the system to be managed is so complex and hard to understand, where the management goals are so ill-defined and contradictory, where experts already abound, each with his favorite and admittedly partial solution, and where the corrective control systems in any case are at best rudimentary if in fact they can be said to exist at all?

Perhaps not, but I believe there are some encouraging precedents. In 1940, for example, the field of military operations and systems management could have been described—and was—in just these bleak, discouraging terms. I am not saying that all the problems in the military systems management field have been resolved or that the systems approach hasn't been occasionally misapplied, but in just 25 years tremendous advances have been made in the art of rational, military decision-making for both planning and operations. The fact that no nuclear war has as yet broken out, in spite of the long standing existence of the capability to wage it and provocations for doing so, is in part a product of such an advance. This systems approach has spread

beyond the Department of Defense to other agencies of the federal government. The promulgation two years ago of the so-called Planning Programming Budgeting System (PPBS) as official practice in presenting agency programs for Bureau of the Budget review is an index. Though it alarms many with its emphasis on planning and its challenge to the traditional methods of power politics and time-honored prerogatives of position, the editors of FORTUNE have called it "the greatest advance in the art of government in nearly a hundred years." Industry, particularly big industry, is adopting it more and more in the form of management information systems and associated objective evaluation practices.

How have decision-makers in government and industry availed themselves of systems techniques? Historically, by establishing or using three different types of R & D institutions. The first is the technology-oriented, innovative institution like the war-time MIT Radiation Lab, the Lincoln Labs, the AEC Labs, and most of NASA. Second is the interdisciplinary advisory group closely coupled to, or perhaps a part of, an agency's decision-making apparatus. The Navy's Center for Naval Analyses, the Joint Chiefs of Staff's Weapons Systems Evaluation Group, and the Department of Commerce's Operations Research Group are examples. Finally come the big, broadly chartered, and multi-disciplinary institutions like the RAND Corporation, funded on a long-term continuing basis and charged with recommending to their sponsor—the Defense Department in RAND's case—better tools, systems, procedures, and instrumentalities for accomplishing the agency mission.

In the environmental field, particularly in the area of economics, Resources for the Future, Inc., is one of the most active institutions. RFF is much smaller than RAND and is a non-captive institution; that is, without a formal agency attachment. My own organization is another non-captive institution, intermediate in size, and more strongly attuned than RFF perhaps to the scientific and management areas, and responsive to the needs of a variety of environmentally-oriented agencies and industries under ad hoc contract relationships.

What, in scientific terms, have systems analysts done, whatever their institutional context? Methodologically, they have united the methods of the physical sciences with the viewpoint of the economist and applied the result to real-life problems of practical management, teaming up with specialists in relevant scientific

fields as need be. Systems analysis emphasizes the importance of mathematical modeling, using techniques which originated with Boltzman and Gibbs and which reached their current culmination in the work of Norbert Wiener, and the cyberneticists. These techniques introduced statistics and uncertainty or probability into the description of phenomena, including physical phenomena, in a much more thorough-going way than had ever been done before; and by doing so they enabled us to model "open systems with feed-back,"—those systems that purposefully process information from the environment and communicate new orders to it; those systems that can at least locally and temporarily reverse the general tendency for the universe, itself a closed system, to tend gradually to greater and greater chaos and randomness, or in physical terms toward maximum entropy, or in environmental terms, "decay."

The computer is the most obvious example of such a system in the world of technology, but living organisms and societies can be understood, says Wiener, in similar terms. In fact, he says that only in such terms can society be understood [9]. For the objectives of environmental management, at least, I believe he is right.

SUBJECTS FOR EARLY CONSIDERATION

If I were asked to nominate specific subjects for early investigation by an environmentally-oriented, well-funded equivalent of the RAND Corporation, for example, I would begin with an effort aimed at developing a quantitative model of the environment. Or rather, I would try to get models of various distinguishable environments, for I suspect we need to define and consider many. Their definition would not only include such factors as geography, terrain, climate, and human habitation category, but—more important—it would explore the perhaps unique set of mutually compatible human uses to which each environment could justifiably be put.

A tropical estuarine wilderness environment, for example, would imply a set of uses, perhaps centered about individual or small-group non-motorized recreation. But in any case it would be a set very different from that appropriate to a temperate inland rural environment, let alone a suburban or urban environment or what have you.

The point is to begin to classify environments in somewhat the way we now zone our cities and towns in terms of mutually compatible uses. Whether this would ever become the basis for regulation through "environmental zoning," it would at least

permit us to inventory the mix of environments we now have and help us see what might happen to each under various projected conditions of use.

Other problem areas I would recommend for early analysis include:

1. Weather and climate modification—here we know inadvertent modification is already taking place and purposeful modification on a significant scale may be only a decade or two away. We need urgently to define our objectives. My thought would be to attempt to stabilize and make more reliable the climates we've already got, rather than try to improve some necessarily at the expense of others. Long-term investments in terms of residential and industrial location, gas and oil supplies, etc., are made on the basis of expected climatic conditions. Losses or disappointments occur when the climate deviates from expectations, even for a year or two. Climatic reliability, year in and year out, would be a tremendous economics boom. If this could be combined with really high reliability forecasts of weather details a few days ahead, it would be hard to ask for more.

2. Pollution control—here the obvious long-term objective is total recycling of wastes.

3. Urban environment design or redesign—here especially the diversity of compatible uses to which a city can be put should be made as explicit as possible. A critical example for many is whether pedestrian or non-motorized transportation is compatible with other forms of transportation. If taking a safe, pleasant walk is felt to be desirable in theory, to get it in practice you may need a commissioner of side-walks to fight the now all-powerful commissioners of roads. And why should they be merely side walks?

4. This brings us to transportation and such general questions as, is safety one of our objectives and if so, how much?

5. Resource management, particularly space utilization, marine resource management, and food.

6. And finally, population, whose unprecedented growth is in a sense the cause of it all. Is it possible or wise to think in terms of population objectives, or at least, using theoretical models of the national and global environments, predict a little more certainty and meaningfully the kinds of human ecosystems we're headed for at various projected levels of population growth?

SUMMARY

I can summarize very quickly. I believe the time has come to recognize environmental decay as an ubiquitous problem of unprecedented complexity and seriousness. We need to recognize environmental quality control as a vital social objective and take steps to establish the field of Environmental Management as a new cross-disciplinary applied science professional activity of extraordinary challenge and importance.

In doing so, we can and should take advantage of the analogy provided by such precedents as military operations research and systems analysis. Five features of these precedents are especially important when taken in combination. They are:

1. The methodological and philosophical advances in the physical and mathematical sciences, begun by Boltzmann and Gibbs and culminating in the work of Wiener, Shannon, and the cyberneticists, which permit the modeling of complex systems with inherent randomness and uncertainty and in particular the purposeful "open systems" characterizing the human social half of the man-environment system,
2. The so-called systems approach of operations research and systems analysis with its emphasis on rational decision-making models and techniques,
3. The new technology, particularly the new information system technology, based on the computer, which has already permitted spectacular advances in modeling one highly complex component of the environment, the atmosphere and its weather, and the application of this technology to observational or environmental monitoring systems,
4. The establishment and linking together with the action agencies of government three types of R & D institutions:
 - (a) innovative, technology, or science-oriented laboratories, pushing the "state-of-the-art,"
 - (b) advisory "think-tanks" of two sorts, one closely linked to the day-to-day or tactical decision problems of agencies, the other broadly chartered to study and advise on the long-term or strategic problems of Environmental Management.

5. The development and cultivation of an outlook which can best be described as ecological, or eco-systems oriented, an outlook which asks what stable and reciprocally-fit man/environment configurations are there and how are the consequences and side effects of actions and events at various levels, personal and social, industrial and governmental, likely to affect the prospects of achieving one or another of these configurations in the future?

I have tried to sketch very briefly some specific problems that I feel are ripe for attack by a program of environmental management studies, with some prospects of success. Such studies and the implementation of their results in the real world will take time, imagination, energy, and statesmanship—both scientific and political—of the highest order. Whether in fact success is achieved is, I believe, more a matter of a conscious decision to organize and fund the necessary effort than it is a matter of available competence. I believe the competence is available, at least to begin.

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5. Subcommittee on Science, Research and Development of the Committee on Science and Astronautics, "Environmental Pollution, A Challenge to Science and Technology," 1966.
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8. Report to Secretary, HEW, by Task Force on Environmental Health and Related Problems, "A Strategy for a Livable Environment," June, 1967.
9. Norbert Wiener, "The Human Use of Human Beings," Cybernetics and Society, Doubleday, 1954.

November 7, 1967

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

Topics for Discussion

1. Selected Social and Economic Aspects of Tsunami Hazard - A Study in Earthquake Engineering -
The proposal in draft by Haas, Garnsey, Ayre
2. Air Pollution, A Case Study of Denver -
Meteorology, economics, public administration and law, social psychology
3. Individual Attitudes and Actions in Response to Warnings of Moderate to Severe Storms -
Social psychology, meteorology, economics
4. Economic and Legal Problems in the Use of the Radio Spectrum -
Economics, law, aeronomy
5. Establishing Priorities for Public Investment (Federal, State and Local) to Improve the Man-Environment-Technology Relationship
6. Research on (and answers to) Destructive Winds, Hurricanes, Tornadoes, and Boulder-Type Winds from the Mountains
7. Methodology for Valuing the Natural Environment (wild rivers, scenic wonders, wilderness and primitive areas are examples) -
Engineering, ecology, geography, economics
8. Study of Re-use of Wastewater of a Municipality by Recycling -
Proposal being prepared by Flack and others
Engineering, medical, economics, sociology, law
9. Reappraisal of Water Rights Doctrine from Management Viewpoint
Law, engineering, political science, economics
10. Population control
11. Ocean engineering
12. Universal Language Adoption and Education
13. Validity of Some Computer Methods Developed for Systematic Biology in Certain Social and Economic Problems -
A feasibility study involving data input from a social problem guided by a sociologist (economist?) working with a team of mathematicians, programmers and biologists.
14. Man-Produced Factors in Determining Urban Climate.

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Lanssey file -

20 Nov 1967

November 2, 1967

Mr. William E. Felling
Program Officer
Resources and Environment
The Ford Foundation
477 Madison Avenue
New York, New York 10022

Dear Mr. Felling:

Here at the University of Colorado we are in the early stages of developing a broad program in Man-Environment Relationships. This program had its inception about two and a-half years ago when the Department of Economics decided to attempt to build unusual competence in areas relevant to quality of the physical environment, such as Welfare Economics, Cost-Benefit Analysis, and Program Budgeting.

Almost immediately, however, the idea spread to embrace other social and physical sciences. The extent of our interest may be indicated by the participation in the current Faculty Research Seminar in Man-Environment Relationships. Senior faculty from several departments are participating, together with strong representation from the National Center for Atmospheric Research (NCAR) and the research institutes of the Environmental Science Services Administration (ESSA) of the Department of Commerce. Parenthetically, the location of these two outstanding environmental research groups in Boulder is a major reason why the University of Colorado enjoys a unique advantage in building a program in this area.

A description of the Seminar and a list of participants is attached to this letter.

We expect that from the Seminar there will grow a plan for a Man-Environment Research Institute at the University. Such an institute would carry on cross-disciplinary research in environmental problems in cooperation with ESSA and NCAR.

Equally important it would offer courses and seminars to graduate students in various aspects of environmental problems. Undergraduate courses could be offered also, should the budget be adequate. As a University we feel that the teaching function must be integrated with research activities. Moreover, there is a rapidly rising demand for social scientists of all kinds, whose training has included a strong emphasis on problems of the quality of the environment. We hope to be able to offer such instruction to superior students, as a part of our Man-Environment Program.

November 2, 1967

The creation of an effective Man-Environment Research Institute lies beyond the anticipated financial resources of the University. Nevertheless an item of \$50,000 for this Program has been included in the Request Budget for Fiscal 1968. We hope, also to receive additional grants or contracts from ESSA, although at present the prospects for funding in the 1968 Federal budget look dark, for reasons with which you are familiar. At the same time, however, I call your attention to the fact that ESSA did support us with a \$25,000 contract to organize a Conference on Human Ecology last January and to publish the "Papers and Proceedings" of the Conference. A copy of the program of this conference is attached to this letter. The "Papers" will be published in January.

As I see it we have two advantages in developing a long-term Program in Environmental Quality. First, we can train graduate students and instruct undergraduates in this area. While this advantage is open to any university, our second advantage is unique. This is the presence within and adjacent to our campus, of ESSA and NCAR. As a result of this fortuitous circumstance we are able to draw upon the scientific resources of two major research institutions dealing with the environment. We can work with them on cross-disciplinary research projects. We have access to their knowledge and advice as scientists. We can call upon them (as we already do as a matter of policy) to become Professors-Adjoint and to teach special seminars or courses in environmental problems.

In short, we feel that the University of Colorado has a great opportunity to build a really significant program of research and teaching in a new and vital area - that of the quality of the physical environment. I hope, also that our plans are of interest to you, and that we could discuss the possibility of a grant application to the Ford Foundation.

Sincerely yours,

MEG:chs
enc.

Morris E. Garnsey
Professor of Economics

The Ford Foundation - Annual Report 1966

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Elsie I. Capozzi, *program assistant*

F. F. Hill, *program advisor*

*until March 1, 1967

**on leave of absence

***representative for East Africa to February, 1967

Science and Engineering - page 15

In the second year of an effort to help preserve the quality of man's physical and biological environment, the Foundation made grants to explore means of preserving open space in metropolitan areas, to develop conservation leadership, and to purchase natural areas of scientific interest.

The Nature Conservancy, a private organization, received a \$550,000 grant to help it expand and reorganize; the Conservancy makes grants and loans to help both private and public agencies preserve natural lands. To strengthen public information and education on conservation in New England and help develop strong local conservation societies, the Massachusetts Audubon Society was granted \$375,000. In New York, funds were granted to the Open Space Action Committee, which has persuaded many owners to keep as much open space as possible in the metropolitan area underdeveloped.

To test new methods of controlling land use, a \$240,000 grant was made for the planning of an experiment in the scenic 21,000-acre basin of the east branch of Brandywine Creek, near Philadelphia. In the experiment, easements and other land rights would be purchased to regulate development of the watershed compatibly with the need for pure water supplies and the open character of the region. The University of Pennsylvania and the United States Geological Survey are working with the Chester County Water Resources Authority to develop the plan.

For fellowships in land-use law, the University of Wisconsin received \$120,000. Recipients will be lawyers who will receive special training to fit them for high positions in resource management.

Grants totaling \$625,000 were made to the Smithsonian Institution and Harvard University for biological field stations to study the relations of plants and animals to their environment. The Smithsonian is purchasing an area of woodland and marsh on the Chesapeake Bay and acquiring rights to an additional area to be kept in its natural state. A field biology center will be set up on the site to serve the Washington-Baltimore area, including the University of Maryland and Johns Hopkins University, and the Smithsonian will develop its own ecological research and training program. Harvard's Museum of Comparative Zoology was assisted in buying a tract of land in Concord, Massachusetts, for a field research station.

To help the National Audubon Society preserve Corkscrew Swamp Sanctuary, part of the Big Cypress Swamp that once covered southwestern Florida, a \$232,000 grant was made. The sanctuary, which contains more than 2,000 acres of cypress trees, some more than 700 years old, is now threatened by real-estate development that is draining adjacent land for house lots. The grant will enable the society to purchase enough additional acreage to maintain the present water level in the sanctuary.

OCT 3 1967

UNIVERSITY OF COLORADO

BOULDER, COLORADO

DEPARTMENT OF ECONOMICS

September 29, 1967

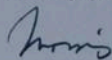
Professor David Rogers
University of Colorado

Dear David:

In the September 1st announcement of the FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS I said, "informal individual discussions among the members concerning the organization of the Seminar, scheduling of topics, etc., will precede the first meeting."

Have you any thoughts about the Seminar which you would like to discuss with me before the 11th? If so, please give me a ring, extension 6409.

Sincerely yours,



Morris E. Garnsey
Professor of Economics

October 31, 1967

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS

Here is a brief list of topics which should give rise to interesting and useful interdisciplinary research proposals. Will you kindly add to the list your own suggested topics, and return the list to me, in the enclosed envelope.

Morris E. Garnsey

1. SELECTED SOCIAL AND ECONOMIC ASPECTS OF TSUNAMI HAZARD - A STUDY IN EARTHQUAKE ENGINEERING -
The proposal in draft by Haas, Garnsey, Ayre.
2. AIR POLLUTION, A CASE STUDY OF DENVER -
Meteorology, economics, public administration and law, social psychology
3. INDIVIDUAL ATTITUDES AND ACTIONS IN RESPONSE TO WARNINGS OF MODERATE TO SEVERE STORMS -
Social psychology, meteorology, economics
4. ECONOMIC AND LEGAL PROBLEMS IN THE USE OF THE RADIO SPECTRUM -
Economics, law, aeronomy
5. ESTABLISHING PRIORITIES FOR PUBLIC INVESTMENT (FEDERAL, STATE AND LOCAL) TO IMPROVE THE MAN-ENVIRONMENT-TECHNOLOGY RELATIONSHIP.

Announcement

FACULTY RESEARCH SEMINAR
IN
MAN-ENVIRONMENT RELATIONSHIPS
1967-68

Attached please find a list of the members of the Seminar
as of now.

Please remember that the first meeting will be on Wednesday,
October 11, 3:00 - 5:00 p.m. in the University Memorial Center, Rm. 158A.

I am happy to inform you that Dr. Willard Libby has offered
to present his views on interdisciplinary study and research at the
Seminar on Wednesday, November 8.

Morris E. Garnsey

enc.

UNIVERSITY OF COLORADO
BOULDER, COLORADO 80302

SEP 6 1967

DEPARTMENT OF ECONOMICS

September 5 1967

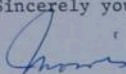
Dr. David Rogers
101 Armory
Campus

Dear Dr. Rogers:

Enclosed please find an announcement of the Faculty Research Seminar in Man Environment Relationships.

No doubt you will remember our conversation about the Seminar this summer. I do hope that you will find it possible to participate as a regular member.

Sincerely yours,



Morris E. Garnsey,
Professor of Economics

MEG:ebe
enc.

Announcement

FACULTY RESEARCH SEMINAR IN MAN-ENVIRONMENT RELATIONSHIPS 1967-68

Background

The University of Colorado has undertaken to develop a program of research and graduate training in problems of the quality of the physical environment--briefly described as the Man-Environment Program. This program was initiated in the Department of Economics where a five-year plan was adopted by the Department on April 19, 1966 and subsequently approved by the Dean of the College of Arts and Sciences and the Dean of the Faculties. Under this plan the Department of Economics will attempt to build exceptional strength in the economic analysis of environmental problems, including Welfare Economics, Valuation of Public Goods, Cost-Benefit Analysis, and Systems Analysis and Program Budgeting.

The decision of the Department of Economics was the first in a broader set of decisions which soon followed. It became apparent to those interested in this area that a cross-disciplinary approach was necessary, which would involve not only other social scientists but also those physical scientists directly concerned with environmental problems. This latter group in the first instance was drawn naturally from the physical scientists of the Environmental Science Services Administration Research Institutes in Boulder and the National Center for Atmospheric Research.

Our first major effort to establish communication among social scientists and natural scientists took the form of a conference on the "Present and Potential Contribution of the Social Sciences to Research and Policy Formulation in the Quality of the Physical Environment" (January 31, February 1, 2, 1967) sponsored jointly by the University and ESSA. This conference was very successful and has led to the decision to organize a faculty Research Seminar in Man-Environment Relationships at the University of Colorado during the academic year 1967-68.

Purposes of the Seminar

One purpose of the Seminar is to explore the possibilities of interdisciplinary research in man-environment relationships and to develop research projects. Such projects will include topics of interest to NCAR and to the mission-oriented functions of ESSA, but will not be confined to them. Following the recommendations of the Conference in Boulder the Seminar also will examine the present capabilities of the leading social sciences for research and graduate training in environmental problems. The Seminar will attempt to identify the most important gaps in the present state of knowledge in the social sciences and define an order of priorities for substantive research programs in the various disciplines. It is hoped that from these efforts it will be possible to formulate the outlines of a broad philosophy of man-environment relationships in to which the particular contributions of individual disciplines may be fitted.

Achievement of these purposes will represent a significant contribution to knowledge and scientific advance. As of today there is a lack of awareness among social scientists of the importance of environmental problems, and an even greater lack of application of the principles and methods of social science to environmental problems. This is due in part to a failure of social scientists to understand fully the nature of the problems and contributions of physical science to environmental problems. There is, also, one might add something less than full appreciation among physical scientists of the role of social science in environmental problems. These generalizations do not apply, of course, to the individual social and physical scientists who will participate in the seminar.

Participants

Attendance at the seminar will be by invitation. There will be regular members, occasional members and visitors. Regular membership will be limited to about fifteen persons. These will include staff members from the university, ESSA and NCAR. At present the following persons have been designated as regular members: Kenneth Boulding, Morris Garnsey, Eugene Haas, James Hibbs, and Bernard Udis. It is hoped that the entire membership can be constituted within the next few days.

Visitors will be asked to lead the discussion of a seminar session or to present papers at meetings of the seminar. The regular members of the seminar will select the visitors. Such persons as Joseph L. Fisher and Allen Kneese of RFF, Richard Meier of Berkeley and Stanley Cain of Michigan have been mentioned as possibilities.

Schedule of Meetings

The first meeting of the seminar will be on Wednesday October 11, 1967 from 3 to 5 p.m. Subsequent meetings will be held on the second Wednesday of each month as follows: November 8, December 13, January 10, February 14, March 13, April 10, and May 8. Suitable readjustment of specific dates may be determined at the pleasure of the members.

It is expected that the place of meeting will rotate among appropriate seminar rooms on the campus and at ESSA and NCAR.

Agenda for the October Meeting

1. General Observations on Social Science and the Quality of the Physical Environment - Kenneth Boulding
2. Agenda for the year- Morris Garnsey

The second item will be preceded in September and October by informal individual discussions among the members concerning the organization of the seminar, methods of procedure, schedule of topics, visitors and schedule of visitors, housekeeping chores etc.

Conclusion

As population expands and scientific and technological discoveries accelerate the relationships of man to his physical environment become more intense both for good and for evil. These relationships must be studied and organized more effectively than in the past. Now as never before we must consider the short and long-run consequences of our attempts to adapt to and manipulate the physical environment.

Morris E. Garnsey
September 1, 1967