Research Studies Constituting the U.S. Contribution to the International Biological Program: Report No. 3 of the U.S. National Committee for the International Biological Program, Part 2 (0)

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NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY OF SCIENCES NATIONAL ACADEMY OF ENGINEERING

2101 CONSTITUTION AVENUE WASHINGTON, D.C. 20418

U. S. NATIONAL COMMITTEE FOR THE
INTERNATIONAL BIOLOGICAL PROGRAM
OF THE DIVISION OF BIOLOGY AND AGRICULTURE

Dear Colleague:

Enclosed is the second installment of Report No. 3 which describes the United States contribution to the International Biological Program (IBP). This contribution takes the form of integrated research programs as well as individual research projects. All are described herein. Additional installments will be distributed at appropriate times in the future.

The International Biological Program is now well into the second year of the 5-year program. Worldwide responses to the aims of the IBP from scientists and governments have been very enthusiastic. Fifty-five countries are participating and all have national programs in being or in various stages of development.

In this country scientists have been responding enthusiastically. The Congress, through Rep. George Miller, Chairman of the Committee on Science and Astronautics, and Rep. E. Q. Daddario, Chairman of the Subcommittee on Science, Research and Development, and others, is supporting the IBP wholeheartedly. The Office of Science and Technology and the Interagency Coordinating Committee are working closely with my Committee to help achieve the aims of the IBP.

The International Biological Program offers scientists everywhere a powerful means of unifying biological knowledge. It also provides an extraordinary opportunity to improve man's ability to survive in a changing world. The challenges presented by the IBP transcend national frontiers and prejudices. The language of science is universal; so are the problems facing man.

I solicit your help in achieving success for the IBP. I urge you to review your research and consider how it might contribute to the aims of one of the integrated research programs. These are all open-ended in anticipation that additional scientists will wish to participate in them. Although the national organization for the IBP has been restructured to meet the needs of the operational program, we have retained the mechanism for review of individual research proposals, and especially for the modification of the integrated research programs as participation increases.

Report No. 3 is given wide distribution. In excess of 60,000 copies of the first installment were printed, of which approximately 10,000 were sent to scientists in other countries. This communication network will improve and increase as additional installments are printed and distributed. In the interest of economy, future reports issued by the U.S. Executive Committee will be sent to those individuals and organizations expressing interest in receiving them. If you wish to receive future reports, please fill in the attached card and return as promptly as possible. Future reports may require a nominal charge.

Sincerely,

W. Frank Blair

W. F. Blair
Chairman, USEC/IBP

RESEARCH STUDIES CONSTITUTING THE U.S. CONTRIBUTION TO THE INTERNATIONAL BIOLOGICAL PROGRAM

REPORT NO. 3 OF THE U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL BIOLOGICAL PROGRAM

PART 2

U.S. National Committee for the International Biological Program
Division of Biology and Agriculture
National Research Council

NATIONAL ACADEMY OF SCIENCES
Washington, D.C.
December 1968

Theme of the U.S. effort in the IBP:

Man's survival in a changing world

PREFACE

The welfare of man is tightly bound to the resources available to him on this planet. These resources are not inexhaustible. If future needs are to be met, man must achieve a better understanding of his environment and must adjust to it more effectively.

The concept of multidisciplinary analysis of whole ecosystems was introduced by subcommittees of the National Committee for the International Biological Program at the Williamstown, Mass., meeting in October 1966. This concept added a new dimension to the National Committee's plan for a scientific program. New vistas have been opened in biology, and biologists have new opportunities to participate in research designed to provide a clearer view of man's relation to his environment.

This report describes two aspects of the U.S. contribution to the IBP:

- Integrated research programs, described in section II.
- Individual projects, descriptions of which are grouped on a subcommittee basis in section IV.

The individual projects cover a wide range both in subject matter and in methods of approach. Some of the scientists are in federal agencies, some are in agencies of state governments, and some are in universities and other nongovernmental institutions. All the projects are relevant to the goals of the IBP.

The term "integrated research program" (IRP), as used in this report, means a multidisciplinary program in which central services, coordination of operations, and integration of results are provided for a group of subprograms and projects. An IRP "subprogram" is a major component of an IRP. (For example, the program on analysis of ecosystems comprises six subprograms, each of which is concerned with a biome. The biomes are grasslands, deciduous forests, coniferous forests, desert, tundra, and tropical forests.) An IRP "project" is a basic element of an IRP. A project may be part of a subprogram or it may be integrated directly with a program.

The U.S. Executive Committee continues to urge biologists and other scientists to participate in the International Biological Program. Guidelines for participation will be found in Appendix D.

U.S. Executive Committee for the
International Biological Program

CONTENTS

I. INTRODUCTION

Our goal should be not to conquer the natural world but to live in harmony with it. To attain this goal we must learn how to control both the external environment and ourselves. Especially we need to learn how to avoid irreversible change. If we do not, we shall deny to future generations the opportunity to choose the kind of world in which they want to live.

Greater understanding will make it possible for man to respond to opportunity as well as to react to need. To gain such understanding is the underlying purpose of the International Biological Program.—Roger Revelle, Report No. 2 of the U.S. National Committee for the International Biological Program

The objective of the International Biological Program is to ensure a worldwide study of (1) organic production in all environments and (2) human adaptation to changing conditions. In the United States, the maintenance of environmental quality is critical for both human welfare and long-term productivity. Thus, the U.S./IBP proposes to initiate studies needed to solve or minimize problems of human adaptability and problems of environmental management. Such studies will constitute the major part of the U.S. contribution to the International Biological Program. They are referred to as *integrated research programs.*

Although it focuses on the integrated programs, the U.S./IBP is interested in other research if it contributes to U.S./IBP objectives. Projects meeting this requirement are referred to as *IBP-related research projects* after they have been approved for inclusion in the IBP. Projects may also be so labeled if they contribute to IBP objectives of another country. Some IBP-related projects are on-going (i.e., they were initiated independently of the IBP).

PROBLEMS OF HUMAN ADAPTABILITY

As a result of rapid technological advances and increasing population pressures, man is so seriously disturbing his environment that he is subjecting himself to a wide variety of stresses and strains. Man is enormously adaptable, but his adaptability has limits, and attempts to exceed them take a toll in disease and death. We must greatly improve our understanding of the processes of human adaptability if we are to cope with the emerging crisis of human survival.

The scientific basis of human adaptability has three major components: the genetic, which sets the limit of the organism's capacity to respond, and the physiological and behavioral, which determine the range of responses available to the organism, given its genetic set. At one extreme of the spectrum of inquiry that can be brought to bear on human adaptability is population genetics, and at the other, environmental physiology. In between, many aspects of modern medicine and anthropology come into play.

Human behavior, in contrast to the behavior of other organisms, includes a large set of cultural activities, the domain of the arts and social sciences. These establish a context, a pattern of civilization, within which human adaptability must operate. The U.S./IBP is concerned with human adaptability as thus limited.

Each U.S./IBP study of human adaptability attempts to exploit certain unusual opportunities to understand critical aspects of the subject. Some of these opportunities will soon disappear because they are associated with vanishing cultures. It can be truly said that we are the last generation of scientists to have the opportunity to study primitive cultures and the first generation to have adequate tools in genetics, molecular biology, and physiology to do it. The U.S./IBP studies will clarify many mechanisms of human adaptation to environmental extremes and to urbanization.

PROBLEMS OF ENVIRONMENTAL MANAGEMENT

An increasing human population coupled with an expanding technology has placed unprecedented stress upon the biosphere, the world environment in which man lives. There are two major consequences. First, more of the productive capacity of the earth is harnessed for the benefit of man; more land is put to productive use. Second, more land is needed for nonproductive uses, for example, roads, housing, and recreation. Without proper management, activities related to the first type of land use become incompatible with those related to the second. Waste and contamination are increased, and the productive capacity of the environment is decreased. Local problems can often be allayed with a "quick technological fix" that shifts the place or time of ultimate solution. We are running out of both places and time.

The scale of these problems is larger than the scale of conventional research. Their solution requires the skills and knowledge of many disciplines, the coordinated efforts of many scientists, the experimental manipulation of large environmental-biological systems, the study of interactions in such systems, and the synthesis of large amounts of information into working models. Only by such an approach can the predictive powers of the separate sciences be integrated to reach the needed level of reliability.

The biological aspects of the environment that constitute the scientific basis of environmental management can be stated in outline form:

A. Changes in plants and animals
   1. Evolutionary adaptations
   2. Physiological and behavioral adaptations
B. Changes in relationships of plants and animals
   1. Interactions with the nonliving environment
   2. Interactions with other organisms
C. Structure and function of ecosystems

Changes that occur in plants and animals in response to variations in their surroundings parallel those that occur in human adaptation. Evolution has produced for each species a genetic composition that limits the environmental responses of

the species. Within these constraints, physiological and behavioral mechanisms define an array of responses that can be used to cope with environmental change. Physiological and behavioral data for the large number of species in the ecosystem of a small watershed, for example, or the several million in the biosphere, will make use of enormous amounts of information already on file. As this information is integrated and the underlying processes become better understood, needs and opportunities for further research will become clear.

The next major aspect in the outline concerns changes that occur in relationships of plants and animals in response to environmental change. The presence or absence of certain species in a region is largely determined by such relationships, and the many relationships of each species present are continually shifting as the environment changes. The effects of changes imposed by man should be predictable if we knew much more about the mechanisms influencing such relationships. Better control of particular species would certainly result. Here the roles of the meteorologist, soil scientist, and chemist are as significant as those of the ecologist, behaviorist, and molecular geneticist.

Taken all together, the interactions within a functional unit of organisms and their environments constitute an ecosystem, which in turn may interact in larger systems, the ultimate being the earth's biosphere, the total system in which organisms participate. The ecosystem is the smallest unit in which environmental management can be applied if problems are to be solved rather than moved. One goal of this program is to learn much more about the structure and function of ecosystems.

II. INTEGRATED RESEARCH PROGRAMS

Human Adaptability Group

INTERNATIONAL STUDY OF ESKIMOS

The Special Committee for the International Biological Program has established a Coordinating Committee for the International Study of Eskimos. Members of the committee are: Frederick A. Milan, United States (Chairman); Robert Gessain, France; David R. Hughes, Canada; and Jørgen Balslev Jørgensen, Denmark.

Initially, this committee will concern itself with cooperative research at Igloolik (Canada), Upernavik and Angamssalik (Denmark, France), and Wainwright, Alaska (United States). Multidisciplinary teams from the four countries will carry out the study, using methods recommended by the World Health Organization and approved by IBP working groups. Each team will be financed by its own country.

The aim of this 5-year study is to elucidate biological and behavioral processes responsible for the successful adaptation and slow population growth of 70,000 Eskimos in an arctic environment. The adaptation of man to a hostile environment, such as that of the Eskimo, is a magnification of the adaptive processes that all men undergo. By studying populations under stress, it will be possible to further the understanding of human adaptability in general.

Following are the research categories, with references to studies that will be included in each:

General health and performance. The cardiovascular system, work capacity, and the antibodies present in the blood and serum.

Child growth. The size, form, and composition of the body at different ages; dentition; and bone mineral content.

Genetics. Genetic markers, population structure, and demography.

Behavior. Cognition, psychomotor and expressive behavior, and behavioral genetics.

Ecology. Quantification of nutritional energy flow through the ecosystem of which the human population is a part.

Besides providing immediate dental and health benefits and growth norms for Eskimos, the studies will contribute to basic knowledge of small-group population genetics, human survival in a harsh environment, and relations between (1) genetics, stress, and environment and (2) disease.

For information concerning the Wainwright study, see Appendix A.

POPULATION GENETICS OF THE AMERICAN INDIAN

Scattered throughout South America there are still to be found tribes of Indians living by hunting, gathering, and simple agriculture, just as we imagine the ancestors of most civilized populations as living thousands of years ago. These tribes provide an opportunity to obtain a base line on the vital statistics and health patterns of primitive man.

U.S. investigators will collaborate with investigators in Venezuela and Brazil. Several very primitive tribes living on tributaries of the Amazon and Orinoco Rivers have been selected for studies of mating patterns, control of fertility, birth and death rates, genetic characteristics, food utilization, and disease pressures. The early effects of acculturation are being explored, in the expectation of linking these studies in time with studies of Indians in the United States. Throughout the United States, but especially in the Southwest, are groups of relatively pure Indians who are midway in the transition from the primitive state to the Atomic Age. These Indians are being called upon to make biological adjustments that in the Old World were spread over thousands of years. Thus, the study of these transitional Indian populations in conjunction with the study of primitive groups should provide important insights into the kind of biological adjustments modern man is being called upon to make, and some of the consequences of these adjustments.

An understanding of the changing stresses of modern man and, possibly, some insight into their consequences can result from careful, quantitative studies such as this one. The studies to date already document changes in breeding patterns and disease pressures that may have had important genetic consequences.

For additional information, see Appendix A.

BIOLOGY OF HUMAN POPULATIONS AT HIGH ALTITUDES

More than 25 million people live at altitudes above 3,000 meters. This number can be expected to expand as worldwide pressure for living space increases.

The stability of ancient high-altitude populations is rapidly disappearing as transportation facilities improve. In some communities, there is a constant influx and efflux, yet the population dynamics of such communities are poorly understood. In particular, the reasons why people leave high altitudes have never been examined systematically. What is the role of biological inability to adapt to chronic hypoxia in comparison with other environmental stresses such as cold and dryness? Equally important may be economic, social, political, or cultural factors.

U.S. and Latin American scientists will collaborate in a study of the following groups:

- A population living at 3,100 to 3,500 meters in the Andes of South America.
- A population living at about 3,100 meters in the Rocky Mountains of North America.
- A predominantly native Andean population living at about 4,000 meters.

In each of these populations, investigations will be in three categories: (1) physiological adaptations to the chronic hypoxia of high altitude from before birth to old age; (2) medical and obstetrical problems that are a direct consequence of

maladaptation to high altitude (e.g., incidence of fetal wastage and malformations); (3) modification of disease by high altitude. In this last category, one provocative hypothesis is that residence at high altitude may protect against degenerative cardiovascular disease.

Study of these populations will allow judgments to be made concerning the relative significance of genetic and physiological processes in human adaptability. The people to be studied in the Rocky Mountain community enjoy such advantages as central heating, adequate clothing, sanitation, refrigeration, adequate nutrition, good medical care, and private transportation. Hence, the primary remaining uncontrollable environmental factor is the reduced atmospheric pressure and the resulting hypoxia. For the Andean populations, who have lived at high altitudes for many generations, these amenities are not readily available. A hypothesis that can be examined is that their adaptation has been primarily genetic whereas in North America the adaptation has been physiological.

The U.S.-Latin American study will be integrated with studies in Ethiopia, India, and the U.S.S.R.

For additional information, see Appendix A.

NUTRITIONAL ADAPTATION TO THE ENVIRONMENT

Nutritional studies in the U.S. program are integrated on a national and international basis with other studies of human adaptation. The results will assist mankind in making adjustments to present and future circumstances in relation to food. The records of anthropology and history and the contemporary world scene all show clearly that man's relative success in obtaining and consuming food that permits a close approach to optimum health is a major factor in efforts to survive and to advance socially and economically.

Experience in arctic, tropical, and temperate areas has resulted in three extreme ranges of food practices that are in sharp contrast in regard to critical margins of success or failure in human adaptability. In circumpolar areas, animals often are the only source of food. Because of this restriction, diets are monotonous and close to the limit of physiological tolerance in their high content of protein and fat and their low content of vitamin C. In tropical areas the reverse is true. Diets there tend to be derived directly from plant sources; they tend to be extremely low in good-quality protein and excessively high in starch or sugar; they are often low in total energy, minerals, and vitamin A. Temperate areas usually permit more varied and more abundant food production and generally a more favorable economic environment.

A major penalty on public health in all climates results from excessive caloric intake, which begins in early childhood and increases with advancing age. The problem of excessive caloric intake is especially severe in more economically advanced countries. The regulating factors involved should be identified very early in life so that a basis for effective adaptation and health conservation can be established. Temperate areas also include populations that contend with stresses of altitude, semidesert conditions, migration, and marginal soil deficiencies. Hence, surveys in addition to basic research are an important feature of many international studies.

Research to establish the nature and practical limits of human adaptability and to improve food resources accordingly will require recognition of genetic variability and carefully controlled studies with experimental animals to supplement research with human subjects.

A special feature of nutritional stress and adaptation is found in a worldwide trend of migration from rural areas into congested urban areas where cultural patterns are confusing and directions of improvements are not well established.

For additional information, see Appendix A.

ECOLOGY OF MIGRANT PEOPLES

The objective of the program on ecology of migrant peoples is to make comprehensive biosocial assessments of migrant populations, emphasizing movements from rural to urban areas.

Biosocial assessments include quantitative ecological descriptions of a group's size and composition, biological (including genetic) and sociopsychological characteristics, habitat, and major behavior patterns so designed as to identify (1) the group's constituent biological populations and (2) the levels of fitness, adaptive mechanisms, and selective pressures characterizing such populations.

Research will improve our understanding of how people who migrate from a rural to a highly urbanized environment adapt to change. Among the factors involved in migration are:

- The physical environmental (increased congestion, noise, and traffic; climatic differences).
- The institutional (impersonal routines and authority; conformity to rigid time schedules).
- The social (changing family patterns; exposure to larger groups, such as gangs; exposure to deviant behavior, such as narcotics addiction).

These factors constitute critical changes in the ecology of migrants.

Work on the ecology of migrants of varied racial and ethnic origin can clarify the broadest common denominator of human response to industrialization. Worldwide, at least a billion people have migrated since World War II; yet very few rigorous biosocial studies of migrants have been conducted.

In this program, priority has been given to source populations (e.g., in Mississippi and Georgia) and receiving areas (e.g., Fairbanks, Alaska, and the inner cities of Chicago and New York) under high physical and sociopsychological stress. An example: Holmes County, Mississippi, appears to be one of the most economically deprived in the United States, and the areas in Chicago (Maywood and the West End) to which Holmes County people have generally migrated have been foci of disturbances.

The proposed work would yield basic data on migration and would contribute directly to attainment of objectives sought by the National Advisory Commission on Rural Poverty and the National Advisory Commission on Civil Disorders. The methods followed would have worldwide relevance, and field operations would provide a basis for programs to alleviate poverty.

For additional information, see Appendix A.

ANALYSIS OF ECOSYSTEMS

Plants and animals live together and interact continually with the nonliving parts of their environment. These ecological systems, or ecosystems, are the units of landscape or seascape of immediate importance to man. Understanding or predicting the responses of ecosystems to man's activities requires knowledge of the whole integrated system as well as of each living and nonliving component.

The purposes of the program on analysis of ecosystems are:

- To learn how ecological systems operate with respect to both short-term and long-term processes (systems disturbed to varying degrees by man are included).
- To analyze interrelationships between land and water systems, so that broad regions may be considered as wholes.
- To estimate existing and potential plant and animal production in the major climatic regions of this country, particularly in relation to human welfare.
- To add to the scientific basis of resource management.
- To establish a scientific base for programs to maintain or improve environmental quality.

For additional information, see Appendix B.

CONVERGENT AND DIVERGENT EVOLUTION

Biologists from several American countries and Australia have planned a cooperative study of convergent and divergent evolution in various groups of plants and animals. The purpose is to improve understanding in these areas:

- Processes and results of divergent evolution of various taxa of widely distributed organisms of the New World.
- Convergent evolution in structure, behavior, and physiological adaptation of ecologically equivalent species and the composition, ecological niches, and functioning of ecosystems that have evolved in similar environments of the Southern and Northern Hemispheres.
- The puzzling relationships between various groups of organisms in South America and Australia. Do the similarities reflect convergence or affinity?
- In Hawaii, processes of evolution under conditions of extreme isolation, and the effects on an insular biota of large numbers of invading plants and animals.

Several subprograms have been organized.

For additional information, see Appendix B.

BIOGEOGRAPHY OF THE SEA

The program on biogeography of the sea seeks to develop the ecological and physiological knowledge required to predict how environmental factors limit or enhance the abundance and productivity of selected marine organisms of interest to man. Attempts will be made to develop knowledge pertinent to the following questions:

- How much physiological variation among populations of a given species is genotypic and how much is environmentally induced?

- What are the isolating factors for species in various marine communities? On what physiological and ecological characteristics does natural selection act?
- To what extent do ecological isolation, behavior, host specificity, food availability, and competition supplement geographic isolation in speciation among marine organisms?
- In the range from relatively stable environments, such as the deep sea, through heterogeneous environments, such as large estuaries, to rapidly fluctuating environments, such as in the intertidal zones, what are the relative selective advantages of stable genotypes, of variable genotypes with polymorphism, and of wide phenotypic liability? Which combinations of capacity for genetic and nongenetic variation are most likely to succeed in an altered environment?
- What are the real limits of productivity in certain marine communities, and can these be modified?
- How do environmental disturbances (e.g., pollution, climatic catastrophe, and changes in fresh-water drainage) affect marine fauna and flora? What physiological detectors of sublethal toxic agents can be found?
- What are the biochemical and physiological mechanisms of environment-organisms interaction? In particular, what are these mechanisms in compensatory acclimation? What changes in metabolic synthesis are adaptive?
- What are the bases for differentiation in tolerance of stress according to levels of biological organization? Why are tolerance ranges of enzymes wider than those of intact organisms? What critical changes underlie alterations in sensitivities to stresses during a life cycle?
- Can sensible mathematical and statistical models be incorporated into a "systems theory" to relate quantitatively the biological parameters (metabolism, growth, etc.) to the environmental parameters (temperature, salinity, etc.)?

Knowledge of the mechanisms of marine productivity is basic to (1) identification of the environmental factors that limit distribution of organisms and help explain evolutionary diversity, (2) definition of optimal environmental and functional conditions useful for assessing aquicultural potentialities for selected species, (3) understanding of the significance of selected marine organisms in trophic chains important to man's welfare, and (4) definition of the adaptive capacity of organisms for life in modified or disturbed environments.

For additional information, see Appendix B.

PHYSIOLOGY OF COLONIZING SPECIES

Plant species invading disturbed habitats will be investigated (1) to learn the characteristics of species that successfully extend their distribution and (2) to determine the role of habitat alteration in promoting invasion by these species. Species studied will range from those that seem to represent a local expansion of a specially adapted type to those that result from broad expansion of a generally adapted type. The habitats that will be evaluated encompass broad latitudinal and altitudinal diversity within the Western Hemisphere. From these studies should come a fuller understanding of the interplay of habitat disturbance and physiological adaptation of the invading species.

The basic characteristics of invading species may include the following: expansion or contraction of the life cycle to fit growing seasons of varying length; the production of chemical inhibitors; the capacity to survive in relatively pure stands; broad tolerance of temperature, light intensities, photoperiods, etc.; relative unpalatability; relative freedom from dependence on a particular insect for pollination; vegetative propagation or other asexual reproduction; self-fertility. The studies will determine which characteristics, if any, promote invasion of a given habitat or invasion at a given latitude.

The research will seek to determine the degree to which invading species have diverged physiologically and biochemically, under the pressure of selective forces in each of a variety of habitats. These comparative studies will yield insight into population adaptation.

Since man's disturbance of habitats plays a major role in the invasion of species, attention should be given to habitat influence. Is the expansion of a species promoted by creation of new habitats that exclude native species? Does the expansion of a habitat-type that fits the niche requirements of a local population lead to expansion of that population? Does the creation of temporary habitats provide the niche requirements of certain invaders? From answers to these questions should come some understanding of the role of habitat disturbance in the invasion of plant species.

For additional information, see Appendix B.

AEROBIOLOGY

This program is concerned with airborne spores, pathogenic organisms, allergenic substances, and biologically harmful pollutants in the air as they may be studied in the context of the IBP. Objectives are:

- To organize, integrate, and extend present investigations of airborne spores, pathogenic organisms, allergenic substances, insects, and biologically significant nonliving materials, such as toxic gases, in coordinated international programs.
- To identify critical problems not yet under investigation and to initiate, or participate in, studies to deal with them.

The IBP provides unprecedented opportunities for attacking these problems, because of the free cooperation between nations and because of concurrent development of schemes (such as those of the World Meteorological Organization, an agency of the United Nations) for global monitoring of environmental and biological phenomena.

The American Phytopathological Society, which for many years has fostered international cooperation for study of plant diseases and amelioration of resulting losses, has placed its IBP advisory committee within the framework of this project to advance research related to phytopathology. This research is in three areas: (1) mode and places of origin of organisms causing plant diseases in major crops, (2) processes by which plant-disease organisms are dispersed, and (3) assessment of worldwide plant-disease losses.

Activities identified with the aerobiology program will be coordinated with

several other IBP activities (primarily, those identified with analysis of ecosystems, the phenology program, and convergent and divergent evolution) and with programs of three scientific societies and several federal agencies.

With relatively modest amounts of "new money," this program will improve the effectiveness of research on atmospheric dispersal of biologically significant materials while taking full advantage of new opportunities for working in the context of worldwide and concomitant investigations.

For additional information, see Appendix B.

PHENOLOGY IN RELATION TO HUMAN WELFARE

Plants and animals undergo rhythmic changes from season to season. These biological rhythms collectively are termed the phenology of the organism. These phenological changes are the organism's responses to regular, seasonally varying meteorological inputs, such as light, heat, and moisture. It is important that we obtain a broader, more predictive knowledge of these changes.

The objectives of the phenology program are: (1) to conduct detailed studies on plant and animal species, both aquatic and terrestrial, at a number of sites within the U.S. in order to prepare phenological maps; (2) to obtain clues to the physiologic limitations that determine the climatic limits of species; (3) to conduct studies that will aid in explaining the biological basis for phenological timing; (4) to test the hypothesis that phenological studies will aid in understanding evolutionary mechanisms; and (5) to contribute to understanding of the role of phenological phenomena in the structure and productivity of ecosystems.

Broad studies will be conducted with the aid of a large network of stations and observers. These studies can be made at several levels of sophistication; people at any level of scientific training can participate. Special sites will be selected, and intensive multidisciplinary studies will be made of environmental parameters, population structure, breeding behavior, and physiology of organisms.

Phenological maps, mentioned in the statement of objectives, would make for greater accuracy in determining proper dates for planting and harvesting crops and would increase scientists' ability to predict occurrence of plant diseases and other biological events.

For additional information, see Appendix B.

CONSERVATION OF ENVIRONMENTS

As populations grow and make heavier demands on their surroundings, the obligation to preserve samples of environments for scientific purposes becomes more urgent. Certain natural and near-natural areas should be set aside so that they will be available for comparative study. Preservation of areas that have been studied for long periods is also desirable.

Some environments already are disappearing, and changes in use are affecting many others. Some experimental areas with records of study extending back several decades are threatened by encroachment of buildings or highways.

The overall purpose of this program is to ensure the protection and preservation of (1) a full range of environments—those that have been little disturbed by man

and those that have been appreciably or considerably disturbed; (2) aquatic and terrestrial areas with long scientific histories; and (3) rare or endangered species, including those that are too wide-ranging to be safeguarded by reservation of areas (e.g., the wide-ranging whales).

A specific goal is to provide registries and descriptions of protected areas and areas requiring protection. Another is to provide guidelines for conservation activities.

Several activities being carried out by government agencies or private organizations are associated with this program. One of these is the revision of *Directory of Research Natural Areas on Federal Lands*, compiled by the Federal Committee on Research Natural Areas. Plans for publishing similar information about other natural areas are being devised by a foundation in cooperation with the IBP. An inventory of freshwater and estuarine areas is already under way. So is a study of mechanisms for assuring protection in marine areas.

For additional information, see Appendix B.

BIOLOGICAL PRODUCTION IN UPWELLING ECOSYSTEMS

The major features of an oceanic ecosystem are determined for many regions by the vertical mixing rate, that is, by the rate at which nutrient-depleted water in the euphotic zone is replaced by nutrient-rich water from below. In tropical and subtropical regions these rates are often low; as a result, there is little biological productivity and blue water. However, along the west coasts of the continents the surface water is driven offshore by the trade winds and is replaced by deeper water. This action is called coastal upwelling.

Regions affected by coastal upwelling are highly productive, often supporting large fisheries. An understanding of the dynamics of production in such regions clearly would contribute to many marine activities, now or in the future, including management of fisheries and aquiculture, pollution control, and artificial upwelling.

The purpose of the IBP program on upwelling is to study biological production processes in upwelling areas. The primary goal is to obtain a quantitative understanding of the effects of an enchanced nutrient supply. With such understanding, it should be possible to predict the dominant species of phytoplankton in some aquicultural endeavors, under conditions of nutrient-containing pollution, and in artificial upwelling.

The upwelling system on the coast of Peru will be studied the first year and a contrasting environment, the Mediterranean Sea, the second year. Two projects, one on aquiculture and the other on a simulation model of the Peruvian ecosystem, will be established. Emphasis will shift from cruises to these projects as the program develops. Scientists from the United States, Peru, and Spain plan to participate. Scientists from additional Mediterranean countries with relevant IBP projects are expected to work in all phases of the program.

For additional information, see Appendix B.

III. RESEARCH STUDIES IN THE PLANNING STAGE

The research studies described in this section have been generated specifically for the IBP. They are in a developmental, or advanced planning, stage but have not been approved by the U.S./IBP Executive Committee. Although they have been treated as potential integrated research programs in planning conferences, their place in the IBP cannot be determined until after approval by the Executive Committee. After a study has been approved, consideration will be given to whether it should be merged with an existing integrated research program, established as a separate program, or identified as an IBP-related research project.

Studies on population dynamics and chronobiology have been suggested but are not described here. If planning reaches an advanced stage, they will be described in the next installment of this report.

CONSERVATION OF GENETIC MATERIALS

The genetic resources of plants by which we live are dwindling rapidly. Yet these are the raw materials on which plant breeding and related agricultural research depend for increasing efficiency of production.

There is a national need to protect these resources through fundamental research and thus provide future generations with powerful means of improving agriculture.

The United States, with no native resources of major crop plants, has U.S. Department of Agriculture programs concerned with introduction, evaluation, and conservation of genetic materials from abroad. The International Biological Program is an opportunity to participate in conservation of genetic materials on a world scale. It is a vehicle for relating research in the academic area to the needs of USDA programs.

Through participation in the IBP, USDA programs will benefit from new inputs in crop evolution, systematics, and plant geography as they relate to world centers of diversity. Participation would offer remarkable opportunities to study primitive crop ancestors and their weedy relatives and thus make possible more effective conservation of this essential base of crop variability.

CROP PRODUCTION UNDER STRESS

The clear necessity of matching food production to the needs of the world's population requires an accurate knowledge of the factors limiting primary production in the various regions and environments of the globe. The objectives of the program

on crop production under stress are (1) to identify the environmental factors that limit production of plant materials, particularly foodstuffs, and (2) to encourage and coordinate research on the nature of the physiological responses of plants to environmental stresses.

Because of limitations of time, funds, and personnel, this program focuses on certain immediate problems of a specific nature in the Western Hemisphere: (1) increasing plant tolerance to drought, (2) increasing plant tolerance to temperature extremes, and (3) increasing rooting zone volume, especially in tropical soils.

The program encourages investigations of environmental factors through an international team approach. Field, laboratory, and model studies will be conducted.

PRODUCTIVITY AND CONSERVATION OF MARINE MAMMALS

Marine mammals constitute an important source of protein and fats. Their exploitation has largely been heedless of biological realities; population after population has been drastically depleted or exterminated. Unfortunately, the adaptation, systematics, distribution, and abundance of most species remain uncertain or unknown, chiefly because the expense of adequate effort at sea is too great for individuals, and for most research institutions, to bear. Cooperation through the IBP seems an appropriate means of remedying this situation.

Research on marine mammals in the fields of systematics, behavior, physiology, acoustics, and anatomy is urgently in need of expansion and integration so that an intelligent approach to this major resource may develop. The IBP offers the best opportunity to bring research-oriented marine mammalogists into a comprehensive, international, nonpolitical program.

The U.S. program will initially establish a Marine Mammal Coordinating Council to integrate existing programs, aid in developing a National Central Museum Repository for specimens at the Smithsonian Institution and a liaison with the National Oceanographic Sorting Center, investigate a training program for students, sponsor international marine mammal symposia, and cooperate closely with several other phases of the U.S./IBP (phenology, human adaptability, biogeography of the sea, etc.).

The U.S. program is in close liaison with the international program through the PM Section of the United Kingdom. Viable programs are already emerging in the United Kingdom, U.S.S.R., Japan, and other countries.

NITROGEN MANAGEMENT: EVALUATION OF INPUTS AND OUTFLOW

Nitrogen fixation in tropical, temperate, and arctic climates will be studied in native environments and under agricultural conditions to determine the extent to which this process contributes to the total nitrogen economy in food production. Factors affecting nonsymbiotic nitrogen fixation will be evaluated, and the extent to which this process can be exploited in the production of food will be estimated.

Sources of fixed nitrogen will be compared with sources of industrial nitrogen as potential contributors to food production in an effort to determine which areas of the

globe will be most dependent—for social, economic, or logistic reasons—upon biologically fixed nitrogen.

The effect that the intensive use of nitrogen fertilizers at high levels could have on the quality of the environment and on food quality will also be explored. Mechanisms whereby the contamination of the environment with excessive quantities of nitrogen can be avoided, and mechanisms for dealing with those situations in which inordinately high levels of nitrate appear in ground waters, lakes, and streams, will be considered.

An effort will be made to determine means for resolving the conflicting requirements of the high nitrogen-fertilizer level for maximum food production on the one hand and the desirability of maintaining tolerable levels of nitrate in ground waters and foods on the other. It is anticipated that important fundamental information relative to the biogeochemistry of nitrogen will also come out of this study.

Additional information will be gained with regard to the so-called nitrogen cycle, and some evaluation of the extent to which atmospheric nitrogen has been cycled in the biosphere will be obtained. This will give a clearer understanding of the evolution of the atmosphere of the earth and, in more general terms, of the evolution of planetary atmosphere.

CHEMICAL INTERACTIONS BETWEEN ORGANISMS

A great variety of substances produced by plants or animals stimulate or depress the development and growth of neighboring organisms. Although local concentrations of solid and liquid wastes or other animal excretions may be sufficient to exert measurable influences, chemicals of plant origin are more abundant and generally are more complex, so that their effects on the natural environment are greater.

The same general groups of chemicals are involved in interrelations between plants and animals. However, owing to the differences in research technique and biological knowledge required to investigate the two general groups of interrelations, they are framed as separate but fully compatible and cooperative programs.

Inhibiting or stimulating effects may be produced by substances released from one plant when they contact another plant of the same or a different kind. The active substances may be synthesized in any part of the donor plant and may be released by volatilization, excretion, leaching, or leakage, or during decay of dead matter. These phenomena appear to be universal in occurrence and of great importance in natural vegetation and in crop growth. They affect productivity (including crop yields) and nutrient cycling (for example, by inhibiting nitrifying organisms).

A program of the U.S./IBP could seek (1) to identify plants that produce such chemicals in natural and managed ecosystems; (2) to develop methods for utilizing active species, or the substances they produce, to obtain greater and more natural control over vegetation and to increase the yield of usable plant materials; (3) to elucidate the pathways of synthesis and movement and sites of accumulation of these chemicals within the donor plant and the manner in which they enter the environment; (4) to describe the pathways of entry and the mechanisms of their action in the receptor plant; (5) to determine the fate of these substances in the environment as affected by microorganisms, soil conditions, fire, and climatic agents; and (6) to

discover the influences of climatic, soil, fire, pathogenic, and other environmental, genetic, and physiological factors on such chemical activity.

BIOLOGICAL CONTROL OF PESTS

Biological control of pests by using their enemies offers distinct possibilities of solving certain of our pest problems in ways that do not aggravate other pest problems or cause deterioration, by pollution, in the quality of the environment. Such deterioration often attends exclusive use of toxic chemicals.

Biological control, together with other compatible measures, is essentially a means of managing our agricultural pest problems with proper concern for long-term human needs in the broadest sense. The method requires sustained and concentrated effort along sound ecological lines, a kind of effort that has been lacking in our conventional pest-control programs.

The biological control program that has been proposed for inclusion in the IBP is designed to explore this area by concentrating effort by highly trained specialists in several appropriate areas. The priorities in this program are: (1) training a cadre of specialists, (2) demonstrating utility in exemplary areas, (3) a supportive information and communications center, and (4) additional supportive research programs.

BIOCHEMICAL AGENTS FOR INSECT-PEST CONTROL

Basic research on insect development and behavior has led to the identification of naturally occurring chemical agents in insects that have profound effects on insect development. Similar basic investigations on the interaction of plants and insects have identified the presence of naturally occurring chemical agents in plants that have marked effects on insect development and behavior. Such natural chemicals may represent the natural protective mechanisms that have evolved in plants to prevent their destruction by plant pests.

Recent developments in these fields open up new areas of research that should be fully exploited in the search for more effective, more economical, and safer ways to control plant and animal pests. Pests destroy up to 30% of the world's food production. They are responsible for some of the most devastating and dreaded diseases of man and animals.

Current chemical agents for controlling insect pests are not selective in their action. They destroy beneficial as well as destructive insects. They create hazards in the environment that can adversely affect our fish and wildlife resources. Many people are concerned about pesticide residues in foods.

Available information on the action of juvenile hormones, ecdysones, and other naturally occurring chemicals derived from plants and animals indicates that such agents probably would control target pests in a highly selective way without hazard to man, animals, and most other organisms in the environment.

A conference of experts in the field of insect-plant interaction recommended a concerted IBP-sponsored research program on:

- The isolation, identification, and structural determination of biochemical agents that occur naturally in plants and animals.

- The effect and mechanism of action of such biologically active agents on insect development and behavior.
- Organic synthesis of natural products known to possess pesticidal action, including analogs and antagonists.
- Laboratory and field tests aimed at the practical development of such selective agents for pest control.
- The ecological impact of the use of such agents on other organisms in the environment.

IV. IBP-RELATED RESEARCH PROJECTS*

PT

105 Analysis of vegetation and soil characteristics of range watersheds in Nevada

Describing and delineating the major vegetative types and associated soils on range watersheds to determine production, condition, and trend of the vegetation for use by hydrologists in watershed analysis. •Research supported by U.S. Department of the Interior.

Agency or institution. Nevada Agricultural Experiment Station, University of Nevada, Reno, Nev. 89507

Investigator. Paul T. Tueller (address same as above)

108 Appraisal of reindeer evaluation techniques

Investigating growth, size variations, and other physiological parameters among reindeer and caribou as they relate to range habitat quality; assessing the validity of the qualitative rumen-analysis technique in the evaluation of reindeer and caribou quality. •Research supported by Bureau of Land Management, U.S. Department of the Interior.

Agency or institution. Alaska Cooperative Wildlife Research Unit, University of Alaska, College, Alaska 99701

Investigator. David R. Klein (address same as above)

107 Arid land ecology and environment

Studying the relationship of forage production to precipitation, soil moisture, temperature, shrub control, grazing treatment, and other physical site characteristics. •Research supported by Bureau of Land Management, U.S. Department of the Interior.

Agency or institution. Wyoming Agricultural Experiment Station, University of Wyoming, Laramie, Wyo. 82070

Investigator. H. G. Fisser (address same as above)

108 Cycling of Cl^{36}-labeled DDT in a natural system

Determining the distribution of Cl^{36}-labeled DDT in a natural system; sampling a wide spectrum of the biotic system for residual levels of the applied toxicant and determining the dynamics of transfer through the food chain by radioassay. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Department of Zoology and Entomology. The Ohio State University, Columbus, Ohio 43212

Investigator. Tony J. Peterle (address same as above)

109 Ecological and phenological interrelations of angiosperms and their pollinators in higher alpine regions

Studying the variety, frequency, and behavior of pollinators (primarily bumblebees from native colonies) foraging on flowers adapted to higher alpine regions; studying the phenological and ecological relations of flower anthesis and pollinator emergence and activity throughout the growing season at elevations from 12,000 to 14,000 feet above sea level. (Research will be done on Mount Evans, west of Denver, Colo.) •Research supported by National Science Foundation.

Agency or institution. Department of Biology, University of Akron, Akron, Ohio 44304

Investigator. Lazarus W. Macior (address same as above)

110 Ecological studies in experimental streams

Evaluating the basic ecological processes in a series of man-made streams; inducing changes in the physical, biological, and chemical makeup of the streams and determining effects on the stream community; studying the flow of some physical or chemical entity through the food web leading to trout production. •In-house research.

Agency or institution. Research Department, Weyerhaeuser Company, Longview, Wash. 98632

Investigator. Rudolph N. Thut (address same as above)

*Projects are arranged by subject-matter areas designated by the abbreviations PT, PF, PP, and so on. The abbreviations refer to subject-matter areas represented in the organization of the International Coordinating Committee of the U.S./IBP. For further explanation, see page 19. The numbers preceding the project titles continue a sequence begun in Part 1 of this report. Their only purpose is to facilitate reference to the project descriptions; the projects themselves do not have these numbers.

IBP Subject-Matter Areas

In Part I of this report, descriptions of research projects were arranged by subcommittees of the U.S. National Committee for the International Biological Program. The subcommittees, whose names described the subject-matter areas for which they were responsible, were as follows:

Productivity of Terrestrial Communities ..... PT
Productivity of Freshwater Communities ..... PF
Production Processes ..... PP
Conservation of Ecosystems ..... CE
Human Adaptability ..... HA
Productivity of Marine Communities ..... PM
Use and Management of Biological Resources ..... UM
Environmental Physiology ..... EP
Systematics and Biogeography ..... SB

The subcommittees have been abolished, but representatives of the subject-matter areas are members of the International Coordinating Committee of the U.S./IBP (see Appendix C). They are responsible for reviewing proposals for studies other than integrated research programs and for facilitating international coordination of programs and projects in the U.S./IBP.

Thus, the abbreviations PT, PF, PP, and so on in this report refer to subject-matter areas, not to IBP subcommittees.

111 Ecology and distribution of mammalian ectoparasites, arboviruses, and their hosts in Venezuela

Studying the ecology and distribution of mammalian arthropod ectoparasites and their hosts in Venezuela; defining the species and mapping their distribution and abundance; setting up an ecological classification and defining the dominant environmental factors limiting populations; converting the data for computer processing and analysis. •Research supported by Medical Research and Development Command, U.S. Department of the Army.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Charles O. Handley, Jr., Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560 (Mammalia and ecology)

V. J. Tipton, Brigham Young University, Provo, Utah 84601 (ectoparasites)

A. Barrera, Escuela Nacional de Ciencias Biologicas, Apartado Postal 42186, Mexico (Coleoptera)

G. Bergold, Departmento de Virologia, Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela (virology)

J. M. Brennan, National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Mont. 59840 (Trombiculidae)

K. C. Emerson, Research Associate, Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560 (Mallophaga)

G. B. Fairchild, Gorgas Memorial Laboratory, Box 2016, Balboa Heights, Canal Zone (Hippoboscidae)

D. P. Furman, Division of Parasitology, University of California, Berkeley, Calif. 94720 (Laelaptidae)

L. R. Guimaraes, Departmento da Agricultura, Caixa Postal 7172, Sao Paulo, S.P., Brazil (Nycteribiidae)

C. L. Hayward, Department of Biology, Brigham Young University, Provo, Utah, 84601 (ecology)

E. W. Jameson, Department of Zoology, University of California, Davis, Calif. 95616 (Myobiidae)

K. M. Johnson, Middle America Research Unit, Balboa Heights, Canal Zone (virology)

P. T. Johnson, Division of Biological Sciences, University of California, Irvine, Calif. 92664 (Anoplura)

G. M. Kohls, National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Mont. 59840 (Ixodidae)

C. Machado, Instituto de Zoologia Tropical, Universidad Central de Venezuela, Apartado Sabana Grande 10098, Caracas, Venezuela (Spinturnicidae, Streblidae, Siphonaptera, and Tur)

E. Mendolxi, Consejo de Bienestar Rural, Apartado Correos del Este 5407, Caracas, Venezuela (Mammalia)

J. Ojasti, Instituto de Zoologia Tropical, Universidad Central de Venezuela, Apartado Sabana Grande 10098, Caracas, Venezuela (ecology)

R. W. Strandtmann, Bernice P. Bishop Museum, Honolulu, Hawaii 96819 (Mysolaelaps)

R. L. Usinger, Division of Entomology, University of California, Berkeley, Calif. 94720 (Cimicidae and Polyctenidae)

R. L. Wenzel, Division of Insects, Field Museum of Natural History, Chicago, Ill. 60637 (Streblidae)

C. E. Yunker, National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Mont. 59840 (Dermanyssidae)

112 Effects of grazing systems on vegetative cover and wildlife habitat

Evaluating livestock grazing systems with reference to their effects on vegetative cover and wildlife habitat in the Salt Desert shrub zone. •Research supported by Bureau of Land Management, U.S. Department of the Interior.

Agency or institution. Wyoming Agricultural Experiment Station, University of Wyoming, Laramie, Wyo. 82070

Investigator. H. G. Fisser (address same as above)

113 Evaluation and management of big game habitats in Nevada

Evaluating potential forage production, palatability, nutrition and species preference of deer feeds, the condition and trend of game habitats, and the degree of dual use and competition with livestock. •Research supported by U.S. Department of the Interior.

Agency or institution. Nevada Agricultural Experiment Station, University of Nevada, Reno, Nev. 89507

Investigator. Paul T. Tueller (address same as above)

114 Nutrient contributions and mycorrhizal status of forest trees

Measuring the amount of nutrients contributed by each of the major species of red spruce in the White Mountains of New Hampshire; analyzing leaf-fall, stem-flow, and root-growth contents of the macronutrients nitrogen, phosphorus, and calcium, and seeking correlations between these nutrient contents and the structural properties of mycorrhizal of the respective tree species; categorizing mycorrhizal patterns of the trees in accordance with the European classification and testing this system in the locale of the present study. •Research supported by Cooperative State Research Service, U.S. Department of Agriculture.

Agency or institution. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, N.H. 03824

Investigator. Thomas E. Furman (address same as above)

115 Organization and processes governing terrestrial ecosystems

Clarifying the organization and processes governing terrestrial ecosystems; showing the relation of these processes to the movement of radionuclides and other pollutants in order to (1) understand man's impact on his environment before damage is done, and (2) predict pathways and the rates of movement of contamination; using tracer nuclides to extend fundamental knowledge of ecological processes and relations (^{137}Cs has been used extensively in a few ecosystems). •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830

Investigators. S. I. Auerbach, Jerry S. Olson, and D. E. Reichle (address same as above)

116 Physiological studies of grassland ecosystems

Conducting research in the following areas: effects of defoliation on growth and development of roots, shoots, flowering, and seed formation; accumulation and storage of carbohydrates and amino acids; evaluations of important range forage and wildlife plants, including in vivo and in vitro evaluations for cattle and wild herbivores (deer and elk); rumen and fecal analyses by point sampling; soil moisture relations and macro-microclimatic factors influencing germination, establishment, and growth of important range grasses, forbs, and shrubs; energy flow of range ecosystems. •In-house research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Weldon O. Shepherd, Southeastern Forest Experiment Station, P.O. Box F, Fort Myers, Fla. 33902 (subtropical forest-grasslands)

S. Clark Martin, Rocky Mountain Forest and Range Experiment Station, P.O. Box 5735, Tucson, Ariz. 85703 (semidesert grassland-desert shrub)

Henry A. Pearson, Forestry Sciences Laboratory, Northern Arizona University, Flagstaff, Ariz. 86003 (conifer woodlands)

Don A. Duncan, San Joaquin Experimental Range Station, Coarsegold, Calif. 93614 (annual grasslands and chaparral)

George A. Garrison, Pacific Northwest Forest and Range Experiment Station, P.O. Box F, La Grande, Ore. 97850 (Montana forests and grasslands and related ranges)

William A. Laycock, Forestry Sciences Laboratory, 860 North 12th East, Logan, Utah 94321 (mountain herbland, brushland, and aspen ranges)

117 Production potential of sagebrush sites in western Colorado as related to geology, topography, soil, and climate

Determining the relationship between (1) sagebrush plant communities and (2) geology, topography, soil, and climate; defining specific range sites within the sagebrush type. •Research supported by U.S. Department of the Interior.

Agency or institution. Colorado Agricultural Experiment Station, Colorado State University, Fort Collins, Colo. 80521

Investigator. Charles Terwillinger (address same as above)

118 Productivity of forest ecosystems

Developing techniques for predicting productivity of forest land, including site-index techniques, interpretation of relation between vegetation and productivity, and soil-site techniques; studying fundamental factors affecting productivity, such as nutrient cycling; studying the effects of soil moisture and soil texture on growth. •In-house research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Raymond H. Brendemuehl, Southeastern Forest Experiment Station, P.O. Box 900, Marianna, Fla. 32446

Willard H. Carmean, North Central Forest Experiment Station, Folwell Avenue, St. Paul, Minn. 55101

Merrill C. Hoyle, Northeastern Forest Experiment Station, Batchelder Building, Dover Road, Durham, N.H. 03824

Louis J. Metz and Carol G. Wells, Southeastern Forest

Experiment Station, Forestry Sciences Laboratory, P.O. Box 12254, Research Triangle Park, N.C. 27709

119 Remote sensing of forest and range resources

Determining the suitability of airborne sensing instruments and photo-interpretation techniques for (1) taking inventory of worldwide forest resources, (2) detecting and mapping vegetation damage resulting from air pollution, (3) detecting loss of tree vigor resulting from insects or disease before visual symptoms appear, (4) identifying and sampling range resources to obtain indications of range use or misuse, and (5) developing automated photo-interpretation with direct computerized readout capabilities. •In-house research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Robert C. Heller, Robert A. Bega, and Philip G. Langley, Pacific Southwest Forest and Range Experiment Station, P.O. Box 245, Berkeley, Calif. 94701

Richard S. Driscoll, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, Colo. 80521

120 Soil and vegetation studies in a Colorado drainage basin

Conducting grassland studies in a drainage basin (known as Badger Wash) near Mack, Colo.; measuring chemical and physical properties and mineralogic constituents of the soil; measuring their effect on runoff and erosion; determining the effects of trampling and grazing on water intake and soil moisture; measuring vegetative characteristics. •In-house research.

Agency or institution. Geological Survey, U.S. Department of the Interior, Washington, D.C. 20240

Investigator. Richard Hadley, Water Resources Division, U.S. Geological Survey, Federal Center, Denver, Colo. 80225

121 Translocation and bio-accumulation of Cl^{36}-labeled DDT in a terrestrial system

Determining the methods of translocation of Cl^{36}-labeled DDT in a terrestrial system; exposing three to six species of birds to a DDT-treated area and determining the rate of residue accumulation; analyzing residue levels by radioassay. •Research supported by Fish and Wildlife Service, U.S. Department of the Interior.

Agency or institution. Department of Zoology and Entomology. The Ohio State University, Columbus, Ohio 43212

Investigator. Tony J. Peterle (address same as above)

PT/PF

122 Analysis of various ecosystems in a successional series in the Piedmont of North Carolina

Studying productivity of a forest ecosystem by a geophysical approach (heat, CO^2, and water vapor transfer) and by a biological approach (secondary production and mycorrhiza and other losses of organic compounds influencing primary production); studying secondary productivity on standard sites with both field and laboratory investigations; studying decomposer activities through soil-respiration measurements as well as by size and activity of fungi, bacteria, and small animals; investigating the basic cycles and metabolic processes of a biocoenotic system; identifying air contaminants and determining their fate in various communities; cooperating with the IBP integrated research program on phenology. •Research supported by the state of North Carolina.

Agency or institution. Department of Botany, University of North Carolina, Chapel Hill, N.C. 27514

Investigators. Helmut Lieth (coordinator; analysis of community structure, environmental gas exchange), C. Ritchie Bell (phenological and evolutionary aspects), A. E. Radford (plant identification), A. E. Stiven (soil arthropods and gastropods), C. J. Umphlett (diversity and size of fungal populations); Department of Botany, University of North Carolina, Chapel Hill, N.C. 27514

Robert L. Barnes (sensitivity of trees to air pollutants), Melvin O. Braaten (data reduction, computer programming), Kenneth R. Knoerr (energy balance, water balance, primary productivity), Charles W. Ralston (nutrient quantity from precipitation in each cover type), William J. Stambaugh (hymenomycetous fungi, air spora patterns), Frank W. Woods (environmental conditions correlated with plant growth, equation of potential biological productivity); School of Forestry, Duke University, Durham, N.C. 27706

S. W. Buol (composition of percolating water, mapping soil features), C. B. Davey (soil water movement and effect on nutrient cycle); Department of Soil Science, North Carolina State University, Raleigh, N.C. 27606

Arthur W. Cooper (primary production and profile measurements), Glenn R. Noggle (productivity profile of North Carolina); Department of Botany, North Carolina State University, Raleigh, N.C. 27607

David E. Davis (mammal grids, bird counts), Department of Zoology, North Carolina State University, Raleigh, N.C. 27607

Henry Hellmers (radiation exchange in relation to the tree canopy), Paul J. Kramer (water stress in the studied plant species); Department of Botany, Duke University, Durham, N.C. 27706

Jacques R. Jorgensen (nitrogen and soil organic matter, CO_2 production, microbial activity), Louis J. Metz (classification and mapping of forest floors, nitrogen and mineral elements, decomposition rates, fauna of the forest floors), Carol G. Wells (nutrient cycling, analysis of litter fall); Southeastern Forest Experiment Station, U.S. Forest Service, P.O. Box 12254, Research Triangle Park, N.C. 27709

George J. Kriz (soil moisture and soil temperature data), Cliff Wiley (oxygen content of the soil); Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh, N.C. 27606

E. A. McMahan (insect taxonomy, ratio of social to nonsocial insects), H. T. Odum (nucleic acid level and neural tissues in links of the food chain); Department of Zoology, University of North Carolina, Chapel Hill, N.C. 27514

Lyman Ripperton (air pollution), Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, N.C. 27514

123 **Comparative stndies of ecosystems on and near Altamaha River (Georgia)**

Studying terrestrial ecosystems near the headwaters of the Altamaha River (Georgia); investigating effects of weathering and organic decomposition in the extensive granite schists and gneisses typical of the Piedmont Plateau in this region; applying multidisciplinary studies to the "island" ecosystems over the rock substrate (includes study of nutrient cycling and metabolic pathways); studying energetics, structure, and homeostasis; investigating population genetics and experimental taxonomy; performing estuarine research on the Altamaha River, including research on benthic species, populations, and ecosystems in brackish water environments; using the research vessel *Driftwood* in conducting studies of tolerance of organisms at all stages of life cycles. •Research supported by National Science Foundation and U.S. Atomic Energy Commission.

Agency or institution. Emory University, Atlanta, Ga. 30322

Investigators. Robert B. Platt, W. D. Burbanck, Charles Ray, C. G. Goodchild, William E. Murdy, P. E. Bostick, Robert Goldstein, William Brillhart, H. L. Ragsdale, and Madeline Burbanck; Department of Biology, Emory University, Atlanta, Ga. 30322

Arthur Allen, Willard Grant, Richard D. Hobson, and Richard Ebens; Department of Geology, Emory University, Atlanta, Ga. 30322

Malcom Turner, Frederick Schmidt, and C. D. Stevens; Department of Statistics and Biometry, Emory University, Atlanta, Ga. 30322

124 **Ecological study of the Rock Creek (Washington) watershed**

Obtaining information and professional opinion on the Rock Creek (Washington) watershed to form the basis for a thorough study of this ecosystem; reviewing property arrangements and ownership to ensure, as far as possible, conservation of this area for long-term ecological study; assessing forest and animal populations, geology and soils, streamflow characteristics, and stream populations in an effort to determine locations of specific study areas. •Research supported by National Science Foundation.

Agency or institution. College of Forest Resources, University of Washington, Seattle, Wash. 98105

Investigators. David R. M. Scott and Dale W. Cole (address same as above)

125 **Equations of chemical cycles for Appalachian forests and contrasting ecosystems**

Developing equations for the processes of nutrient circulation in ecosystems, relating them to data in hand, and thus improving the quantitative basis for comparing ecosystems of similar or contrasting character; using compartment models and computer simulations of systems to show the consequences of specified coefficients on probable behavior of whole ecosystem networks; testing the derived models with data on tulip poplar and pine forests and heath stands obtained by the University of Tennessee and Oak Ridge National Laboratory; evaluating the variations in coefficients of transfer to establish a framework for ecosystem programs. •Research supported by National Science Foundation.

Agency or institution. University of Tennessee, Knoxville, Tenn. 37916, in cooperation with Oak Ridge National Laboratory, Oak Ridge, Tenn. 37830

Investigators. Edward E. C. Clebsch, Department of Botany, University of Tennessee, Knoxville, Tenn. 37916 Jerry S. Olson, Oak Ridge National Laboratory, Oak Ridge, Tenn. 37830

126 **Objectionable algae in reservoirs**

Conducting limnological studies in reservoirs to determine the kinds and quantity of algae growths, periods of stratification and overturn, and methods of controlling objectionable algae; measuring the gross primary productivity of the reservoirs by the light and dark bottle technique; studying the rate of carbon assimilation by the major species of phytoplankton; analyzing water samples for nitrites, ammonia nitrogen, nitrates, and silicon in an attempt to correlate concentrations of these materials with the occurrence of different forms of phytoplankton. •Research supported by Federal Water Pollution Control Administration, U.S. Department of the Interior.

Agency or institution. Department of Zoology and Entomology, University of Utah, Salt Lake City, Utah 84112

Investigator. Arden R. Gaufin (address same as above)

PT/PP

127 **Biochemistry of ozone injury to pines**

Studying the effects of ozone on the metabolism of two important pine species, white pine (*Pinus strobus* L.) and loblolly pine (*P. taeda* L.); determining basic physiological and biochemical responses to ozone exposures under controlled environmental conditions and correlating these responses with visible injury symptoms; analyzing the effects of controlled environmental preconditioning on sensitivity to ozone. •Research supported by U.S. Department of Health, Education, and Welfare.

Agency or institution. School of Forestry, Duke University, Durham, N.C. 27706

Investigator. Robert L. Barnes (address same as above)

PT/PM

128 **Ecological study of forest ecosystems in Costa Rica**

Completing an inventory and general ecological studies in two forest ecosystems (one wet, one dry) in Costa Rica; initiating and developing a variety of studies related to the organization, structure, functioning, and productivity of the ecosystems; developing studies on the reproductive biology of plants in the ecosystems; initiating various studies relative to insect and animal populations; organizing information on all components of the ecosystems into a comprehensive discussion of problems in the use and management of the tropical forest resource. •Research supported by National Science Foundation.

Agency or institution. Organization for Tropical Studies, Inc., The University of Michigan, Ann Arbor, Mich. 48104

Project Director. Stephen B. Preston (address same as above)

Project Coordinator. Dale W. Cole, College of Forest Resources, University of Washington, Seattle, Wash. 98105

Investigators. James S. Bethel, College of Forest Resources, University of Washington, Seattle, Wash. 98105 (facilities for two lowland forest sites in Costa Rica, laboratory development)
Stanley P. Gessel, Organization for Tropical Studies, Inc., The University of Michigan, Ann Arbor, Mich. 48104 (assessment and inventory, analyses of mineral cycling and productivity)
Herbert G. Baker, Botany Department, University of California, Berkeley, Calif. 94720 (reproductive biology)
Daniel H. Janzen, Department of Biology, University of Chicago, Chicago, Ill. 60637 (effect of dry seasons on the structure and dynamics of arboreal insect populations, insect reference collection)

PF

129 Algal species as indicators of water quality

Characterizing water quality in New Hampshire watersheds by utilizing distribution, periodicity, and abundance of algal species as indicators; establishing a biological basis for detecting water pollution and predicting ensuing algal problems; providing basic information on the types of algal populations associated with different levels of water quality; studying algal blooms and their interrelationships with other organisms. •Research supported by Office of Water Resources Research, U.S. Department of the Interior.

Agency or institution. Department of Botany, University of New Hampshire, Durham, N.H. 03824

Investigator. Arthur C. Mathieson (address same as above)

130 Arctic-alpine pollination ecosystems

Studying total pollination interrelationships in selected alpine and arctic plant communities to examine pollination in the context of community ecology and with respect to transfers in the local ecosystems; studying general role of insects in pollination of alpine and arctic plants; examining, in terms of the arctic-alpine environment, parallel evolution of diverse plant groups with respect to pollination mechanisms. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Stanwyn G. Shetler and Jerry Stage (address same as above)
Peter H. Raven, Department of Botany, Stanford University, Palo Alto, Calif. 94305

131 Biogeochemical relationships between aquatic organisms and their environment

Developing basic data regarding the biogeochemical relationships between aquatic organisms and the chemical composition of their environment; making these data available for improving our ability to predict the environmental behavior of radionuclides; contributing to an understanding of the mineral nutrition and productivity of aquatic organisms; providing insight into the environmental consequences of nuclear technology. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830

Investigators. S. I. Auerbach and D. J. Nelson (address same as above)

132 Dissolved organic matter and photosynthesis in lakes

Studying dissolved organic matter in lakes to obtain a qualitative and quantitative evaluation of its roles as nutrient sources and as complexing agents for inorganic nutrients in algal and macrophytic metabolism; seeking information on the amounts of naturally produced organic compounds required to affect inorganic cycles and photosynthetic metabolism; determining the rates of extracellular excretion of organic matter by submerged macrophytes and attempting to ascertain whether excreted organic matter is utilized by other producers; determining the quantitative significance of dissolved organic matter produced in the littoral regions of various lake habitats as a factor influencing control of inorganic nutrient cycles of an entire lake. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Kellogg Gull Lake Laboratories, W. K. Kellogg Biological Station, Michigan State University, Hickory Corners, Mich. 49060

Investigator. Robert G. Wetzel (address same as above)

133 Habitats for anadromous and resident fish

Evaluating and improving productivity of freshwater communities important as habitats for anadromous and resident fish; studying effects of logging, roadbuilding, livestock grazing, and streamside management on these communities; evaluating habitat conditions by measuring stream temperatures, suspended sediments, and bedload deposits and by tracing population trends and species composition of stream fauna; evaluating effects of removing log jams, cleaning gravel, and other corrective measures. •In-house research; U.S. Fish and Wildlife Service, state conservation agencies, and universities are cooperating.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Austin E. Helmers, Institute of Northern Forestry, Juneau, Alaska 99801 (effects of logging on salmon habitat; southeastern Alaska)
Robert R. Ziemer, Pacific Southwest Forest and Range Experiment Station, P.O. Box 245, Berkeley, Calif.

94701 (logging, water quality, anadromous fish; Redwood region)
Richard L. Hubbard, Pacific Southwest Forest and Range Experiment Station, P.O. Box 245, Berkeley, Calif. 94701 (stream fauna population; Redwood region)
Dean H. Urie, North Central Forest Experiment Station, East Lansing, Mich. 48824 (water quality, resident trout; Lake states)

134 Limnology of Yellowtail Reservoir and Big Horn River (Montana)

Investigating the physical, chemical, and biological limnology of the Yellowtail Reservoir and its downstream effect on the Big Horn River (Montana); relating the cycles of effects from physical, chemical, and biological activities to the water regime, which involves deep-water discharges; comparing the effects of these activities on the heat, salinity, and nutrient budgets with the effects of surface-water withdrawals; relating the downstream effects of discharging nutrient-rich cold water on productivity, benthic algal production, and the heat budget of the Big Horn River; following population dynamics of zooplankton over a 5-year period to note whether changes occur that could explain decreases in productivity of reservoirs that occur after initial high productivity; correlating changes in the zooplankton populations with reciprocal changes in the phytoplankton population; using areal hypolimnetic oxygen deficit of the dead storage zone of the reservoir as an index of the overall productivity of the reservoir over a 5-year period. •Research supported by U.S. Department of the Interior.

Agency or institution. Center for Environmental Studies, Montana State University, Bozeman, Mont. 59715

Investigator. John C. Wright (address same as above)

135 Organic materials and mineral elements transported from watersheds into streams

Studying the quantities and kinds of organic materials and mineral elements transported from watersheds into streams; analyzing these materials in the streams to determine their subsequent utilization and fate; studying ways in which physical features of the landscape, the chemical nature of the soil, and biological activity from vegetation, animals, and microorganisms contribute to this utilization; conducting research to increase our understanding of biogeochemical interrelationships between aquatic habitats and their watershed and to develop a better definition of the critical natural parameters relating to water quality; seeking a better understanding of problems of pollution by determining quantitatively base-line aspects of water quality and of materials naturally associated with streams; characterizing the interactions between land and water biota through coordinated efforts of scientific disciplines such as limnology, zoology, botany, pedology, chemistry, and hydrology; achieving a more complete understanding of the factors regulating and maintaining natural ecosystems. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830

Investigators. S. I. Auerbach, D. J. Nelson, and J. W. Curlin (address same as above)

136 Sea lamprey research and control

Determining the various environmental factors that influence the survival, growth, and age at metamorphosis of the sea lamprey; developing effective and economical means for control of the sea lamprey in the Great Lakes, and applying and evaluating the success of these methods. •In-house research supported by Great Lakes Fishery Commission.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Bernard R. Smith, BCF Biological Station, P.O. Box 758, Marquette, Mich. 49855
John H. Howell, Bureau of Commercial Fisheries, Hammond Bay Laboratory, RFD, Millersburg, Mich. 49759

137 Synthesis and utilization of dissolved organic matter by aquatic microflora

Determining sites and rates of synthesis of littoral dissolved organic compounds; evaluating the rates of transfer of such compounds among the sessile and planktonic flora and their utilization in metabolism; experimenting with axenic and natural algal and microphytic populations to provide evaluation of organic compounds produced extracellularly by submerged macrophytes in relation to the requirements and cycles of benthic and epiphytic algae to obtain data on chemoorganotrophic utilization of dissolved organic substrates by attached algae and phytoplankton and to ascertain quantitative relationships between the macrophytic, periphytic, and littoral phytoplanktonic populations on an annual basis under varying ecological conditions. •Research supported by National Science Foundation.

Agency or institution. W. K. Kellogg Biological Station, Kellogg Gull Lake Laboratories, Michigan State University, Hickory Corners, Mich. 49060

Investigator. Robert G. Wetzel (address same as above)

138 Systematics, biology, and evolution of North American barbeled Cyprinidae

Analyzing groups of species of the genus *Nocomis* possessing a number of characteristics, such as nest construction, brilliant breeding colors, and development of nuptial head tubercles and crests, that set these Cyprinidae (or chubs) apart from others; investigating the three characteristic groups that have evolved within the genus *Nocomis* and the extent of population divergence; investigating those aspects of biology of the species within the genus that are particularly oriented toward a more comprehensive understanding of systematics and evolution; correlating the systematics, biology, ecology, and distribution of the various species with physiographic areas and geological history; studying the utilization of the "active" nest of *Nocomis* as spawning sites by other species of fishes belonging to the several genera of Cyprinidae; studying the biological significance of this utilization and its influence on

the reproductive potential and population dominance among the contributing species. •In-house research.

Agency or institution. Division of Fishes, Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Ernest A. Lachner (address same as above)

139 Transfer of matter and energy from producers to herbivores and from herbivores to carnivores

Under controlled conditions, culturing primary producer freshwater algae (including *Chlamydomonas, Cosmerium, Scenedesmus,* and *Stichoccus*) and feeding them to groups of herbivores, obtained from a single clone, and as far as possible of the same age and size in identical food-free media; feeding small carnivores with the above herbivores with similar procedures; incorporating C-14 into the algae and tracing the radioactivity through the food chain in parallel experiments; studying metabolism by tests on fecal matter and environmental water; analyzing results for different species, different feeding levels, and different temperature regimes. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Department of Biology, Western Reserve University, Cleveland, Ohio 44106

Investigator. Charles C. Davis, Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada

140 Watershed studies of grassland ecosystems

Conducting research in the following areas: evaluation of livestock grazing management systems on infiltration, runoff, and soil stability; characteristics of plant cover and soil required to prevent accelerated overland flow and soil erosion; soil, atmospheric, and water requirements for successful revegetation of depleted range sites; effects of converting cover types on water yield; effects of ripping and contour trenching on moisture penetration and runoff. (Data are obtained from field plots and watersheds and from controlled environments in laboratories.) •In-house research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Paul E. Packer, Forestry Sciences Laboratory, U.S. Forest Service, 860 North 12th East, Logan, Utah 84321 (protection requirements, summer ranges)
Earl F. Aldon, Rocky Mountain Forest and Range Experiment Station, New Federal Building, 517 Gold Avenue, Albuquerque, N. Mex. 87101 (rangeland erosion control)
Jerome S. Horton, Forest Hydrology Laboratory, U.S. Forest Service, Arizona State University, Tempe, Ariz. 85281 (brush-grass conversion)

PF/PT

141 Comprehensive study of small undisturbed and man-manipulated ecosystems (watersheds)

Quantifying the input-output relationships of undisturbed and man-manipulated ecosystems (watersheds); computing nutrient budgets, weathering and erosion rates, and energy-flow parameters; correlating the effects of variations in the hydrologic cycle, season, or ecosystem biology with the nutrient cycle and energy flow; studying the natural loss of chemicals from humid terrestrial ecosystems; analyzing the withdrawal and recycling of various nutrients by terrestrial animals associated with small drainage streams. (This work is done in cooperation with the U.S. Forest Service.) •Research supported by National Science Foundation.

Organizations. 1. School of Forestry, Yale University, New Haven, Conn. 06504

2. Department of Biological Sciences, Dartmouth College, Hanover, N.H. 03755

Investigators. F. H. Bormann (address same as in 1, above)
G. E. Likens (address same as in 2, above)

142 Use of computers and mathematics in data reduction, simulation of ecosystems, and data retrieval

Using computers and mathematics in data reduction, simulation of ecosystems or their components, and retrieving data for theoretical and applied ecology; combining theoretical, analytical, and experimental approaches to solving complex environmental problems; exploiting the use of mathematical, statistical, and analog and digital computer techniques; applying these techniques to (1) modeling and analysis of ecological problems, (2) total-systems research in which systems analysis is combined with use of radionuclides or radiation, (3) investigation of large-scale natural resource problems, and (4) storage and retrieval of ecological parameters and literature. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830

Investigators. S. I. Auerbach, Jerry S. Olson, and S. V. Kaye (address same as above)

PF/PP

143 Ecological factors controlling growth of an aquatic vascular plant in sterile culture

Determining the conditions of optimal growth of *Salvinia* in sterile culture, in the presence and absence of a nitrogen fixing alga and extracts of this alga; conducting quantitative and qualitative assays on common nitrogenous compounds produced and excreted by the algal cultures; tracing the nitrogenous compounds from the alga into *Salvinia* to show what factors control *Salvinia* growth. •Research supported by National Science Foundation.

Agency or institution. Department of Biological Sciences, State University of New York, Stony Brook, Long Island, N.Y. 11790

Investigator. John J. Gaudet (address same as above)

PF/PM

144 Anadromous fish resources

Providing for allocations and contracts to 31 coastal and Great Lakes states for conserving, developing and enhancing the nation's anadromous fish resources, including Great Lakes fishes that spawn in tributary streams; expanding Pacific salmon research and development of salmon hatcheries; coordinating research by the states on sport fish, alewife control, and establishment of high-value species in the Great Lakes. •In-house and state research.

Organizations. Bureau of Commercial Fisheries and Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Edward E. Hueske, Bureau of Commercial Fisheries, 1801 N. Moore Street, Rosslyn, Va. 22209 (administrator for BCF)

Lynn H. Hutchens, Bureau of Sport Fisheries and Wildlife, Division of Federal Aid, Room 342, 777 14th Street, N.W., Washington, D.C. 20005 (administrator for BSFW)

BCF associates: Paul R. Nichols, 1801 N. Moore Street, Rosslyn, Va. 22209; I. B. Byrd, 144 First Avenue South, St. Petersburg, Fla. 33701; Harvey Moore, 1319 Second Avenue, Seattle, Wash. 93101; William Beckman, BCF, 14 Elm Street, Gloucester, Mass. 01930; Edward Whitesel, BCF, 5 Research Drive, Ann Arbor, Mich. 48103; Fred Thorsteinson, BCF, P.O. Box 2481, Juneau, Alaska 99801

BSFW associates: Edward S. Marvich, BSFW, Division of Federal Aid, 777 14th Street, N.W., Washington, D.C. 20005; John G. Appelget, BSFW, 10006 Lake Street, Minneapolis, Minn. 55408; John L. Savage, BSFW, 730 Pacific Street, P.O. Box 3737, Portland, Ore. 97208; Joseph Yovino, BSFW, U.S. Post Office and Courthouse, Boston, Mass. 02101; Louis A. Villanova, 809 Peachtree-Seventh Building, Atlanta, Ga. 30323

PF/EP

145 Biological implications of weather modification

Determining the ecological effects of the winter orographic storm seeding program on grassland vegetation on selected 10-acre fenced sites; determining the basic cover and percentage composition of the plant species constituting the vegetative communities under natural conditions; harvesting quadrats weekly to determine dry-matter production, moisture content, and chemical decomposition of selected plant species; obtaining phenological data related to soil moisture, temperature, and microclimate; analyzing grasshopper populations to determine species composition, distribution, and density; studying immediate and long-term ecological effects of local snowpack modification and effects of modifying local rainfall regime on small instrumented and controlled plots. •Research supported by National Science Foundation.

Agency or institution. Center for Environmental Studies, Montana State University, Bozeman, Mont. 59715

Investigators. John C. Wright (address same as above)

Don D. Collins, Department of Botany and Microbiology, Montana State University, Bozeman, Mont. 59715

Ellsworth B. Hastings, James H. Pepper, and Norman L. Anderson, Department of Zoology and Entomology, Montana State University, Bozeman, Mont. 59715

A. Hayden Ferguson, Department of Plant and Soil Science, Montana State University, Bozeman, Mont. 59715

Arlin B. Super, Department of Earth Sciences, Montana State University, Bozeman, Mont. 59715

Charles Bowman, Department of Agricultural Engineering, Montana State University, Bozeman, Mont. 59715

146 Movements of sharks in San Juan River and Lake Nicaragua

Tracking the movements of *Carcharhinus leucas* in the San Juan River of Central America and in Lake Nicaragua to learn whether the sharks move from the sea into the lake, to determine the patterns of their movements within the river and the lake and the length of their stay in freshwater, and to learn whether they return to the sea after having been in the lake. (Involves conventional tagging and sonic tagging.) •Research supported by U.S. Department of the Navy.

Agency or institution. Department of Zoology, University of Nebraska, Lincoln, Nebr. 68508

Investigator. Thomas B. Thorson (address same as above)

PP

147 Biochemistry of drought tolerance in range grasses

Conducting a comprehensive biochemical study of germinating seeds to determine the ability of drought-resistant and susceptible species and selections to synthesize phosphate esters and nucleic acids at low water potentials. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigator. A. M. Wilson, Crops Research Division, ARS, Agricultural Experiment Station, Washington State University, Pullman, Wash. 99163

148 Biological fixation and transformation of nitrogen in small impoundments

Learning the rates at which nitrogen enters artificial ponds by biological processes and the rate at which it undergoes nitrification and assimilation by organisms; measuring rates of nitrogen fixation in two small impoundments; measuring rates of assimilation of ammonia

and nitrates by the biota of a prairie pond; measuring, concurrently, rates of nitrification in the same environment; relating seasonal changes in nitrate and ammonia to these rates. •Research supported by U.S. Department of the Interior.

Agency or institution. Research Foundation and Department of Zoology, Oklahoma State University, Stillwater, Okla. 74070

Investigator. Dale Toetz (address same as above)

149 Biological fixation of nitrogen

Examining in detail the properties of the individual components of the purified N_2-fixing enzyme; establishing molecular weights; determining metal content, amino acid composition, and, if feasible, amino acid sequence in the components from various organisms; crossing fractions 1 and 2 of the enzyme complex from various N_2-fixing agents to determine whether in combination they can fix N_2; studying in detail the kinetics of N_2-fixation with the pure enzyme complex; investigating the nature of the binding of N_2 and other substrates and the role of metals of the enzyme complex in the binding process; comparing reduction of N_2 with reduction of N_2O, azide, acetylene, cyanide, and isocyanide; examining the effect of N_2 and other substrates and inhibitors on the UV, visible, and EPR spectra; studying the metabolism of H_2 and the exchange reaction of H_2, using individual components of the enzyme complex; conducting field studies of N_2 fixation and acetylene reduction in lakes and soils and by leguminous and nonleguminous root nodules. •Research supported by National Science Foundation; National Institutes of Health, U.S. Department of Health, Education, and Welfare; and Office of Water Resources Research, U.S. Department of the Interior.

Organizations. 1. Department of Bacteriology, University of Wisconsin, Madison, Wis. 53706

2. Department of Biochemistry, University of Wisconsin, Madison, Wis. 53706

Investigators. P. W. Wilson (address same as in 1, above)
R. H. Burris (address same as in 2, above)

150 Breeding, genetics, and physiology of safflower

Conducting a comprehensive breeding program on safflower, including evaluation of germ plasm with special reference to cold, heat, and drought tolerance; testing selections for yield, oil content, and disease resistance; determining the relationship of stress factors to yield. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. L. H. Zimmerman and Varon Jensen, Crops Research Division, ARS, Agronomy Department, University of Arizona, Tucson, Ariz. 85721

151 Climatology and physiology research on citrus trees

Determining the relation of climate to coldhardiness, fruit quality, productiveness, and drought resistance of citrus; evaluating orchard heaters relative to cold injury; conducting basic studies on growth regulators relative to dormancy and fruit coloring and abscission. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. W. C. Cooper, G. A. Rasmussen, and G. Yelenosky; Crops Research Division, ARS, U.S. Horticultural Field Laboratory, 2120 Camden Road, Orlando, Fla. 32803

B. J. Rogers, Crops Research Division, ARS, California Institute of Technology, Pasadena, Calif. 91109

J. R. Furr, Superintendent, U.S. Date and Citrus Station, Indio, Calif. 92201

R. H. Young, Crops Research Division, ARS, Weslaco, Tex. 78596

152 Collection of organism types (American Type Culture Collection)

Establishing a comprehensive collection of organism types (currently consisting of bacteria, fungi, human and animal viruses, bacterial viruses, plant viruses, human and animal cell lines, protozoa, and algae); propagating, preserving, and distributing these cultures, tissues, and materials for use in research, education, and other scientific and industrial activities; undertaking research to ensure authenticity and long-term stable preservation of the materials in the collection and to improve and standardize methods; providing technical information and services within the field. •Support received from National Institutes of Health, U.S. Department of Health, Education, and Welfare; from National Science Foundation; and from culture fees.

Agency or institution. The American Type Culture Collection, 12301 Parklawn Drive, Rockville, Md. 20852

Director. William A. Clark (address same as above)

153 Farmstead windbreaks

Developing methods for the establishment and maintenance of effective farmstead windbreaks in the Great Plains; measuring the effect of windbreaks on air, soil, water, and snow movement and on response and yield of crops in the vicinity of windbreaks. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. E. J. George, Crops Research Division, ARS, U.S. Northern Great Plains Research Center, Mandan, N. Dak. 58554

Robert Hetzler, Soil and Water Conservation Research Division, ARS, U.S. Northern Great Plains Research Center, Mandan, N. Dak. 58554

154 Improvement of perennial warm-season range grasses

Identifying critical needs in range-grass improvement; studying selection and breeding for optimum seed set, seed size, seedling vigor, seed dormancy, and salt and drought tolerance of adapted warm-season range grasses. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigator. L. N. Wright, Crops Research Division, ARS, Agronomy Department, University of Arizona, Tucson, Ariz. 85721

155 Physiological interrelationships between rhizobia and the host legume

Studying the energy and nitrogen metabolism of *Rhizobium japonicum;* isolating, purifying, and determining the mode of action of a nodulation-inhibiting root exudate previously found in a non-nodulating soybean; investigating the nodulation process by comparative physiological and nutritional studies of several strains of *Rhizobium* forming sparse nodules in the normally non-nodulating plant and the more typical rhizobia that will not invade this plant; studying the effect of tetraploidy in the meristematic root regions upon the nodulation process and determining the relationship between the number of tetraploid centers and the number of nodules formed; studying the developmental morphology of nodule formation. •Research supported by National Institutes of Health, U.S. Department of Health, Education, and Welfare, and by National Science Foundation.

Agency or institution. Department of Microbiology, School of Agriculture and Life Sciences, North Carolina State University, Raleigh, N.C. 27607

Investigator. Gerald H. Elkan (address same as above)

156 Photosynthetic activity and utilization of solar energy by forest and rangeland communities

Evaluating energy balance as a measure of evapotranspiration from forest and range ecosystems and as a basis for predicting water yields resulting from alteration of vegetative cover; measuring energy components (including albedo, light spectra, net radiation, and all wave radiation) above, within, and under tree crowns and over snow surfaces in forested and cleared areas. (Microenvironment of harsh range sites is used as a clue to factors affecting revegetation of deteriorated sites. Research includes investigation of sampling requirements and techniques for measurement of energy components.) •In-house research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Herbert W. Berndt, Forest Hydrology Laboratory, U.S. Forest Service, 1133 North Western Avenue, Wanatchee, Wash. 98801 (Cascade snow zone)

James L. Smith, Pacific Southwest Forest and Range Experiment Station, Box 245, Berkeley, Calif. 94701 (Sierra snow zone)

Marvin D. Hoover, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, Colo. 80521 (Rocky Mountain snow zone)

Bertram C. Goodell, Rocky Mountain Forest and Range Experiment Station, Forestry Building, Colorado State University, Fort Collins, Colo. 80521 (Rocky Mountain snow zone)

Jerome S. Horton, Forest Hydrology Laboratory, U.S. Forest Service, Arizona State University, Tempe, Ariz. 85281 (Phreatophyte vegetation)

Robert S. Pierce, Northeastern Forest Experiment Station, Batchelder Office Building, Dover Road, Durham, N.H. 03824 (Northeastern hardwoods)

Raymond E. Leonard, Northeastern Forest Experiment Station, c/o State University College of Forestry, Syracuse, N.Y. 13210 (Northeastern hardwoods)

Kenneth G. Reinhart, Timber and Watershed Laboratory, U.S. Forest Service, P.O. Box 430, Parsons, W. Va. 26287 (Appalachian hardwoods)

James E. Douglass, Coweeta Hydrologic Laboratory, U.S. Forest Service, P.O. Box 601, Franklin, N.C. 28734 (Southern Appalachian hardwoods)

157 Photosynthetic behavior of a number of ecotypes of Douglas fir

Developing instrumentation to investigate the photosynthetic behavior of Douglas fir from the Pacific Northwest, northern Rocky Mountains, and southern Rocky Mountains and the effects of internal moisture stress on photosynthetic rates; constructing five cuvettes so that photosynthesis can be measured simultaneously to avoid confusing effects of the normally fluctuating external environment; developing techniques for maintaining airflow rates, vapor-pressure deficits, and leaf temperature close to those of the external conditions; determining differences in photosynthetic behavior of the various ecotypes. •Research supported by National Science Foundation.

Agency or institution. Forest Research Laboratory, Oregon State University, Corvallis, Ore. 97330

Investigators. H. Irgens-Moller, W. K. Ferrel, and R. H. Waring (address same as above)

158 Soil chemistry of the rhizosphere as it affects mineral nutrition and growth of plants

Conducting studies in which podzolized and latisolized soils are compared; in these studies, examining the interaction between plant roots and the soil of the rhizosphere as it affects mineral nutrition of plants and the growth and development of roots; comparing ion activities and ion ratios in rhizosphere soils (with roots present) with nonrhizosphere soils by means of equilibrium water and dilute calcium chloride solutions; investigating the contribution of naturally occurring organic complexing agents. •Research supported by Cooperative State Research Service, U.S. Department of Agriculture.

Agency or institution. Department of Plant and Soil Science, Vermont Agricultural Experiment Station, University of Vermont, Burlington, Vt. 05401

Investigator. Richmond J. Bartlett (address same as above)

159 Symbiosis of *Rhizobium* with leguminous plants

Characterizing the substances formed by the root-nodule bacteria and by leguminous plants that are required for nodule initiation and development of the legume-*Rhizobium* symbiosis; investigating the chemical and biochemical differences between root-nodule bacteria that enter into the symbiosis and closely related strains or mutants that are unable to develop the association; studying the chemical basis of the symbiotic specificity of microorganism and plant. •Research supported by National Science Foundation.

Agency or institution. Department of Agronomy, Cornell University, Ithaca, N.Y. 14850

Investigator. Martin Alexander (address same as above)

160 Symbiotic nitrogen fixation in nonleguminous plants

Investigating host-endophyte relations in nonleguminous plants by pure culture inoculation; investigating cross inoculation between species of the same genera and between genera; investigating the factors that cause variation in nodulation potential in soils. •Research supported by National Science Foundation.

Agency or institution. Department of Soils, School of Agriculture, and the Agricultural Experiment Station, Oregon State University, Corvallis, Ore. 97331

Investigator. C. T. Youngberg (address same as above)

161 Thermal inactivation of plant growth

Investigating the physiological and biochemical nature of thermal inactivation of plant growth; determining whether lethal temperatures, although visually manifested in the shoot, are first perceived by the root; clarifying the biochemical basis of thermal inactivation of growth through a better understanding of the chemical communication between the root and the shoot, labile systems in the root responsible for synthesis of the metabolite, and implications of the lack of the metabolite in the shoot; clarifying mechanisms that determine susceptible and tolerant varieties. •Research supported by National Science Foundation.

Agency or institution. Department of Floriculture and Ornamental Horticulture, Cornell University, Ithaca, N.Y. 14850

Investigator. Peter L. Steponkus (address same as above)

162 Tung breeding

Originating late-blooming, more frost-hardy tung varieties. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. S. Merrill, Crops Research Division, ARS, U.S. Field Laboratory for Tung Investigations, Bogalusa, La. 70427

J. T. Raese, Crops Research Division, ARS, U.S. Field Laboratory for Tung Investigations, Big Bend Horticultural Laboratory, Monticello, Fla. 32344

163 Variance in photosynthetic capacities exhibited among genotypes of corn

Determining the effect of stage of development and position of leaf on the variance in photosynthetic capacities that occurs within and among genotypes of corn; determining the variance of respiration rates within and among selected genotypes of corn as exhibited by roots, leaves, ears, seedlings, and whole plants; determining whether it is possible to develop strains of inbreds having extremely high capacities for photosynthesis and other strains having low capacities; determining the relation between (1) the different photosynthetic responses among identified inbreds and single-crosses to moisture stress and (2) associated differences in physical and biochemical properties. (These activities constitute one phase of a continuing project whose aim has been to test the hypothesis that the photosynthesis and respiration are related in a predictable way to growth and that their rates under given environmental conditions may be controlled by combinations of genetic factors that are subject to modification.) •Research supported by National Science Foundation.

Agency or institution. Department of Agronomy, Cornell University, Ithaca, N.Y. 14850

Investigator. Robert B. Musgrave (address same as above)

164 Winter injury and the short life of peach trees

Determining effects of temperature and chilling in predisposing peach trees to short life; developing methods to prevent injury by climate modification or by use of insulating or reflecting materials on orchard trees. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. E. F. Savage, Crops Research Division, ARS, Georgia Experiment Station, Experiment, Ga. 30212

F. L. Crosby, Environmental Science Services Administration, Georgia Experiment Station, Experiment, Ga. 30212

CE

165 Bald eagle studies

Studying the bald eagle of the Everglades National Park and surrounding areas; determining the ecology of the species; determining (by banding, food analysis, and observation of reproductive success of mated pairs) possible threats to the only normally reproductive population of the species in the Eastern United States; observing juvenile behavioral patterns. •In-house research.

Agency or institution. National Park Service, U.S. Department of the Interior, Washington, D.C. 20240

Investigator. William B. Robertson, Jr., Everglades National Park, P.O. Box 279, Homestead, Fla. 33030

166 Effects of man on the stability of alpine vegetation

Studying the effects of visitor activities on the stability of certain alpine and subalpine vegetation; analyzing soil with special reference to compaction effects and experimental plots; measuring controlled disturbance effects. •Research supported by National Park Service, U.S. Department of the Interior.

Agency or institution. Department of Botany, Duke University, Durham, N.C. 27706

Investigator. Ernest A. Hartley (address same as above)

167 Hurricanes and the ecology of coastal vegetation in southern Florida

Investigating the ecological role of hurricanes in the coastal regions of Everglades National Park by documenting the changes in vegetation effected by hurricanes

and other variables and subsequent successional patterns, through use of study plots. •Research supported by U.S. Department of the Interior and National Geographic Society.

Organizations. U.S. Department of the Interior, Washington, D.C. 20240

National Geographic Society, Washington, D.C. 20036

Investigators. F. C. Craighead, Sr., P.O. Box 825, Homestead, Fla. 33030

D. W. Scholl, Geological Survey, U.S. Department of the Interior, Menlo, Calif. 94025

168 Reestablishing the black-footed ferret in South Dakota

Surveying locations of black-footed ferrets in South Dakota; analyzing the ecological relationships of this endangered species and prey species in their natural habitat in order to maintain the ferret in its natural habitat and reestablish the species where previously extirpated. •Research supported by National Park Service, U.S. Department of the Interior, and South Dakota Cooperative Wildlife Research Unit.

Agency or institution. South Dakota Cooperative Wildlife Research Unit, South Dakota State University, Brookings, S. Dak. 57006

Investigators. Raymond L. Linder and Conrad N. Hillman (address same as above)

169 Relict plant communities

Securing information concerning the ecology of relict upland forest and woodland communities in Gaudalupe Mountains National Park by mapping the principal stands and describing them by various techniques; making suggestions relative to the effects of development and visitation upon these communities. •Research supported by National Park Service, U.S. Department of the Interior.

Agency or institution. Department of Biology, University of New Mexico, Albuquerque, N. Mex. 87106

Investigators. Loren D. Potter and James L. Robinson (address same as above)

170 Sequoia tree inventory and vegetative-cover mapping

Conducting an inventory of the *Sequoia gigantea* in Sequoia and Kings Canyon National Parks to determine the size and shape of each grove, record the number of trees in each diameter class, and determine the size and location of the trees and certain of their characteristics; developing an overlay vegetative-cover map for the associated vegetation within the Sequoia groves and establishing 100 permanent 1/2-acre sample plots; compiling the required data for future studies on spread or recession of groves, the effect of fire, and limiting factors of slope, soil, and altitudes. •Research supported by National Park Service, U.S. Department of the Interior.

Agency or institution. Western Timber Services, Inc. P.O. Box 603, Arcata, Calif. 95521

Investigators. Everett E. Givens, Ron Hunt, Ned Simmons, Robert Graham, and Everett L. Givens (address same as above)

171 Vegetation-environment relations at Whiteface Mountain in the Adirondacks, New York

Refining ordination techniques for describing communities in a small area of widely divergent vegetation and environment; evaluating existing methods and developing new techniques for measuring and describing the environment of forest communities; developing new statistical and mathematical techniques for relating vegetation ordinations to quantitative measurements of environment; testing a portable meso-micrometeorological network prior to using it for measurement of energy balance in forest stands. •Research supported by National Science Foundation.

Organizations. 1. Department of Science, State University College, Oneonta, N.Y. 13820

2. Department of Earth and Atmospheric Sciences, State University of New York, Albany, N.Y. 12203

Investigators. J. Gary Holway (address same as in 1, above)

John T. Scott (address same as in 2, above)

CE/PT

172 Ecology and physiology of saguaro

Analyzing the ecology and physiology of saguaro to establish the bases for decline of saguaro populations and for the failure of the Cactus to reproduce and become established; investigating (1) environmental and physiological mechanisms controlling the survival and seasonal mortality of saguaro tissues under stress, (2) the nature and extent of destructive rodent pressure on saguaro of various ages, (3) ecology of the saguaro tree-hole habitat, and (4) the critical nocturnal and diurnal physical factors controlling the localized establishment of young saguaros. •Research supported by National Park Service, U.S. Department of the Interior.

Agency or institution. Department of Zoology, University of Arizona, Tucson, Ariz. 87521

Investigator. Charles H. Lowe (address same as above)

173 Mammals of Panama

Compiling information on the distribution, ecology, and systematics of the mammals of Panama; producing a manual on tropical mammalogy to provide basic data for further zoological and medical research (a related volume, *Ectoparasites of Panama,* has been published). •In-house research; cooperative with Gorgas Memorial Laboratory, Republic of Panama, Middle America Research Unit, Balboa, Canal Zone, and Environmental Health Division, U.S. Army, Fort Amador, Canal Zone.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Charles O. Handley, Jr. (address same as above)

E. L. Tyson, Office of Ecology, Smithsonian Institution, Washington, D.C. 20560

T. H. Fleming, Museum of Zoology, University of Michigan, Ann Arbor, Mich. 48104

CE/SB/PT

174 Population biology of the rodent *Geocapromys ingrahami* of Plana Cay, Bahamas

Studying the population ecology and behavior of the rodent *Geocapromys ingrahami*, the only mammal on the island of Plana Cay, which exists without predation and attains a high biomass; observing population density, territoriality, behavior patterns, food consumption, and total influence of the population on the island vegetation. •Research supported by National Science Foundation.

Agency or institution. Department of Zoology, University of Rhode Island, Kingston, R.I. 02881

Investigator. Garrett C. Clough (address same as above)

HA

175 Anthropology of aging and disease

Studying physical change, personality, personal history, and physiologic efficiency in samples of medical students over a period of years to analyze aging phenomena; analyzing differences in hypertension, obesity, rheumatoid arthritis, thyrotoxicosis, and varicose veins; on the basis of data on genetic and environmental backgrounds, determining possible causes of differences in certain diseases among individuals. •In-house research.

Agency or institution. Division of Physical Anthropology, Smithsonian Institution, Washington, D.C. 20560

Investigator. J. Lawrence Angel (address same as above)

176 Biological information retrieval system

Determining the feasibility of a biological information retrieval system that would incorporate the taxonomist's concept of character (descriptor) and character state (descriptor state) and have the following applications, among others: (1) implementing an efficient computing algorithm for storing, updating, and retrieving information; (2) making available a language (TAXIR) with sufficient power and flexibility to enable the user to input information and pose inquiries in whatever terminology is natural to his field of investigation; and (3) eliminating the need for computer specialists to stand, as interpreters, between the biologist and his information retrieval system. •Supported by National Science Foundation.

Agency or institution. Department of Biology, University of Colorado, Boulder, Colo. 80302

Investigators. David J. Rogers, Henry S. Fleming, Robert C. Brill, George F. Estabrook, and Gilbert N. Hersh (address same as above)

177 Differentiation in two population isolates in New Guinea

In collaboration with the Australian National Committee for the International Biological Program, obtaining demographic, anthropometric, family, and genetic data from two population isolates in northeastern New Guinea. (The objective is to obtain, through fieldwork and laboratory determinations, information that will add to our understanding of biological change and development in human populations.) •Research supported by National Institutes of Health, U.S. Public Health Service.

Agency or institution. Department of Anthropology, Harvard University, Cambridge, Mass. 02138

Investigator. Eugene Giles, Department of Demography, The Research School of Social Sciences, The Australian National University, P.O. Box 4, Canberra, Australia.

178 Effects of displacement from a savanna to a forest environment

Identifying the principal factors affecting societal and personal adjustments to a new forest habitat of the Ramkokamekra Canela of north-central Brazil, better known as Nimuendaju's Timbira (movement from a savanna into the forest occurred in 1963); studying ecological, social, and psychological aspects of the transition; seeking to determine causes of failures to adjust. •In-house research.

Agency or institution. Division of Latin American Anthropology, Smithsonian Institution, Washington, D.C. 20560

Investigator. William H. Crocker (address same as above)

179 Genetics in medicine; gene action in man

Conducting an interdisciplinary and internationally coordinated broad program of research to provide a more fundamental understanding of gene action in man at the level of molecules, individuals, cells, and populations. (The program includes: biochemical studies of G6PD deficiency and other human enzymatic variants; studies of embryonic, fetal, abnormal hemoglobins, and thalassemia; investigations in pharmacogenetics; biochemical studies of development; population genetics of red cell traits; linkage studies on man; studies on the relation of genetics markers to disease; studies on the role of immunity in the etiology of chromosomal aberrations; genetics of autoimmunity; studies in cytogenetics; carrier detection in X-linked diseases, studies on selected diseases in clinical genetics; genetic counseling; studies on somatic cell genetics; and investigations of the mechanism of X-chromosomal inactivation.) •Research supported by National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

Agency or institution. Departments of Medicine and Genetics, University of Washington, Seattle, Wash. 98105

Investigators. Arno G. Motulsky (principal investigator), Stanley Gartler, Philip V. Fialkow, Eloise Rosalie Giblett, Akira Yoshida, George Stamatoyannopoulos, Jean S. Bryant, and Amelia L. Schultz (address same as above)

P. Fessas, Director of Hematology, Alexandria Hospital, Athens, Greece

180 Human facial cold response as related to race and form

Testing relationships between the human facial form (protrusion, fat-padding) and thermal responses of facial skin to cold air stress; analyzing nonmorphological causes

of thermal variation (race, vasoreactivity); exposing two racial subsamples of Caucasoid and Mongoloid individuals to cold air stress; defining relationship of variation in facial skin temperature to the anthropologically significant traits; interpreting the results as to their adaptive significance in living man, and in fossil members of our genus. •Research supported by National Science Foundation.

Agency or institution. Department of Anthropology, College of Arts and Sciences, State University of New York, Buffalo, N.Y. 14214 (in collaboration with the University of Hawaii)

Investigator. A. T. Steegmann, Jr. (address same as above)

181 Medical-anthropological studies in the Solomon Islands

Relating culture, biology, and disease in a spectrum of Solomon Island societies varying with respect to ethnic and racial background, ecological setting, and exposure to Western civilization; obtaining data on six primitive groups: those in the Lau Lagoon and adjoining Baegu bush areas of Malaita, the Aita and Nagovisi on Bougainville Island, and two others to be selected; promoting multidisciplinary studies of such primitive populations by analysis of data concerning evolutionary process, natural selection, etiology of disease, and cultural patterns of illness and reaction to illness. •Research supported by National Institutes of Health, U.S. Department of Health, Education, and Welfare.

Agency or institution. Department of Anthropology, Peabody Museum, Harvard University, Cambridge, Mass. 02138

Investigators. William W. Howells, Douglas L. Oliver, Albert Damon, and Eugene Giles (address same as above)

182 Performance of individuals and small groups under stress

Assessing the synergistic effects of a complex of variables on the performance of isolated man under stress (mountain climbers), with particular reference to cold and altitude and with primary emphasis on neuropsychological functions that are particularly sensitive to hypoxia, the objective being to contribute (1) to the solution of practical problems involving human performance and (2) to our general view of the critical adaptations of man as a species; studying aspects of work physiology; evaluating reaction of small groups subject to multiple stressors; studying adaptation of native races to cold and hypoxia; studying adaptation of animal species to high altitude. •Research supported by Medical Research and Development Command, Department of the Army.

Agency or institution. Department of Zoophysiology, University of Alaska, College, Alaska 99701

Investigator. Peter Morrison (address same as above)

183 Prehistoric land use patterns in the Southwestern United States

Investigating the changing ecology of a limited part of the Puebloan Southwest, and interpreting successive human ecological patterns in terms of cultural processes; selecting suitable areas in the Colorado Plateaus of New Mexico and Arizona for examination of past resources, subsistence systems, and population distribution in time and space; expanding the "settlement pattern" concept to consider land use patterns, soil and water resources, indigenous biota, and mineral resources. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Richard B. Woodbury and Nathalie F. S. Woodbury (address same as above)

164 Preindustrial management of water resources in arid areas for agricultural purposes

Studying prehistoric and recent water systems of preindustrial groups in the southwestern United States and Mexico; comparing the findings with available data from similar levels of culture in the Middle East; examining interrelations of water supply, technology, and social systems, with emphasis on simpler societies or preindustrial civilizations. •In-house research; in collaboration with University of Oregon, University of Arizona, and University of Maryland.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Richard B. Woodbury (address same as above)

John Q. Ressler, Department of Geography, University of Oregon, Eugene, Ore. 97403

James A. Neely, Department of Anthropology, University of Arizona, Tucson, Ariz. 85721

Aubrey Williams, Department of Sociology and Anthropology, University of Maryland, College Park, Md. 20742

185 Social biology and ecology of culture change

Investigating implications of the observation that, from Neolithic to modern times in the general area around the Eastern Mediterranean, advance (or decline) in culture has correlated significantly with increase (or decrease) in longevity, in body size, in population mixture, and in relative freedom from arthritis, dental disease, and osteoporosis; seeking to determine whether there are regular causal and positive feedback interrelations between human biology (health, microevolution) and culture; seeking to estimate the extent to which such biological changes are directly ecological and the extent to which they are evolutionary. •In-house research.

Agency or institution. Division of Physical Anthropology, Smithsonian Institution, Washington, D.C. 20560

Investigator. J. Lawrence Angel (address same as above)

PM

186 Atlantic herring biology and dynamics

Studying the distribution, abundance, population dynamics, growth, and behavior of herring in the Gulf of Maine and on Georges Bank; relating the distribution and abundance to (1) the distribution and abundance of zooplankton

forage organisms and (2) physical factors in the environment; studying serological, biochemical, and meristic characteristics of herring and applying these characteristics to the problem of defining geographic races of herring. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Bernard E. Skud, George J. Ridgway, Joseph Graham, Kenneth Sherman, Vaughn Anthony, John E. Watson, and Alden P. Stickney; BCF Biological Laboratory, West Boothbay Harbor, Maine 04575

187 Benthic ecology of the U.S. Atlantic continental shelf

Studying (1) the biomass and general distribution of benthic organisms on the continental shelf and slope; (2) relationships between benthic organisms and grain size and organic content of sediments, depth, temperature, and salinity of water; (3) effects of the mixing of fresh and saline waters at river mouths, in large estuaries, and over the open continental shelf; and (4) the fate of dissolved ions and sediment loads discharged by rivers into brackish and marine water. •Research supported by Geological Survey and Bureau of Commercial Fisheries, U.S. Department of the Interior.

Agency or institution. Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543

Investigator. K. O. Emery (address same as above)

188 Biological, chemical, and radiochemical studies of marine plankton

Defining and describing the distribution of marine plankton organisms and the factors that control the rate of growth of these populations, emphasizing hydrography, chemistry of inorganic nutrients and organic compounds, microbiology (with particular reference to nitrifying bacteria), dynamics of phytoplankton production and physiology, phytoplankton and zooplankton distribution, uptake and release of specific radioisotopes, degradation of organic carbon and chlorophyll, grazing by zooplankton, and responses of organisms to controlled environmental factors. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543

Investigators. Bostwick H. Ketchum, Darek Spencer, and Stanley Watson (address same as above)

189 Biology, physiology, and behavior of California current fishes and their food organisms

Describing energy interrelationships in the sea between trophic levels; studying the biology, physiology, and behavior of individual populations occupying different feeding levels; emphasizing laboratory studies of planktonic crustaceans (e.g., copepods and euphausiid shrimps), the Pacific sardine, northern anchovy, and jack mackerel; investigating, under controlled conditions, in the laboratory and in the field, schooling behavior of fishes, communications between members of a fish school and the effects of schooling of exogenous factors; studying the behavior and physiology of the feeding process in pelagic fish; quantitating empirical techniques for rearing pelagic fish; investigating larval fish mortality/survival of laboratory-reared pelagic fish. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Reuben Lasker, John R. Hunter, Charles O'Connell, and George O. Schumann; Bureau of Commercial Fisheries, Oceanography Center, La Jolla, Calif. 92037

190 Coastal and estuarine ecology

Expanding knowledge of the families, genera, and species of fishes, shrimps, and other organisms occurring along the Atlantic coast of the United States (life histories, abundance, distribution, and ecology); studying the early stages in the life histories of finfishes of a tidal zone in coastal Georgia; determining species and size of groups of fish occurring in several habitats; analyzing data and combining them with other data on selected important fish families. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigator. Jack W. Gehringer, BCF Biological Laboratory, Brunswick, Ga. 31520

191 Ecological and zoogeographic studies on the Atlantic continental shelf and slope

Investigating the zoogeographic distribution of the species and genera of Foraminifera and Ostracoda occurring in 2,500 samples from the continental shelf and slope from Nova Scotia to Key West; comparing species ranges with faunal provinces already established on other groups to define more accurately the limits of the provinces and to ascertain characteristic foraminiferal and ostracode assemblages; analyzing changes in faunal composition that occur with depth, the purpose being to delineate the assemblages that characterize depth zones; ultimately, providing data with which the geographic and stratigraphic distribution of the late Cenozoic species can be compared to determine the paleogeography of the Atlantic coast during the last 40 million years. •In-house research.

Agency or institution. U.S. Geological Survey, U.S. Department of the Interior, Washington, D.C. 20242

Investigators. Joseph E. Hazel and Thomas C. Gibson (address same as above)

192 Ecological effects of normal environmental variables and low-level pollution stresses on metabolic requirements for maintenance and growth of gulf coast fishes

Determining levels of metabolic and growth rates of *Mugil cephalus, Lagodon rhomboides,* and *Cynosein nebulosus* that live in brackish to hypersaline waters with respect to both normal seasonal variations in stresses (temperature, salinity, oxygen, swimming activity, body weight) and slight additional stresses (man-made pollution, temperature elevations, salinity increases); constructing relatively simple models for predicting minimal requirements for growth and maintenance of a given species over a wide range of stress conditions; using field and

laboratory studies for controlling some of the stress variables. •Research supported by National Science Foundation.

Agency or institution. The University of Texas Marine Science Institute, Port Arthur, Tex. 78373

Investigator. Donald E. Wohlschlag (address same as above)

193 Ecological studies of the marine red alga *Chondrus crispus*

Investigating, in the laboratory and in the field, the basic ecology, life history, regeneration, propagation, and reproduction of *Chondrus crispus*, including (1) a descriptive analysis of stands of *Chondrus crispus*, (2) denuded-quadrat succession, (3) regeneration measurements, (4) transplant studies, (5) photosynthesis measurements, and (6) nutrient and salinity studies; studying the potentialities of Irish moss in support of improved methods for aquiculture. •Research supported by National Science Foundation.

Agency or institution. Department of Botany, University of New Hampshire, Durham, N.H. 03824

Investigator. Arthur C. Mathieson (address same as above)

194 Ecology of Foraminifera

Investigating the living Foraminifera from localized environments around tropical islands, from deep sea deposits, and from near-shore environments (such as fjordlands, shallow estuaries, marshes, and streams); providing a basis for interpretations regarding depth, temperature, currents, salinity, nearness of land, and other conditions under which deposits of Foraminifera-bearing sediment were laid down. •In-house research.

Agency or institution. U.S. Geological Survey, U.S. Department of the Interior, Washington, D.C. 20242

Investigator. Ruth Todd (address same as above)

195 Effect of biologic reworking of marine sediments on infaunal composition and distribution

Investigating a potentially important ecologic factor that can be observed only in undisturbed sediments, that is, the influence of biogenic reworking of sediments on the structure of the sediment-water interface; evaluating biologic modification of the sediment-water interface as a factor controlling, in part, (1) vertical distribution of certain meiofaunal invertebrates within sediments, (2) morphologic adaptations of infaunal benthos, and (3) feeding type distribution; investigating the relationships and interactions between biogenic reworking, sediment-water interface stability, and the trophic structure of benthic communities. •Research supported by National Science Foundation.

Agency or institution. Department of Geology, Yale University, New Haven, Conn. 06504

Investigator. Donald C. Rhoads (address same as above)

196 Effects of nutrients on the growth of phytoplankton in the tropical Pacific Ocean

Defining, by batch culture studies, the nutrient requirements of various phytoplankton in the tropical Pacific Ocean, with attention to growth rates and final yields; in chemostat culture, establishing various degrees of nutrient deficiency and expressing them as fractions of the maximum growth; measuring effects of deficiency on cellular composition and assimilation ratios and comparing them with similar compositions and ratios of natural populations; predicting possible phytoplankton growth and standing crop. •Research supported by National Science Foundation.

Agency or institution. Scripps Institute of Oceanography, University of California, San Diego, Box 109, La Jolla, Calif. 92038

Investigator. William H. Thomas (address same as above)

197 Environmental ecology and acoustical behavior of arctic seals

Identifying and studying the underwater sounds of marine mammals, especially the Pinnipedia, of the arctic region; determining the role of acoustics in their social and orientation behavior; assessing the suitability of ice and water clarity for the establishment of a sub-ice observation chamber in the arctic region; preparing a design and logistics of a sub-ice observation chamber for long-range physiological ecology and acoustical behavior studies. •Research supported by Arctic Institute of North America under contractual agreement with the Office of Naval Research.

Agency or institution. Department of Pathobiology, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Md. 21205

Investigator. Carleton Ray (address same as above)

198 Fish larvae studies

Studying fish larvae of waters off the South Atlantic coast of the United States to determine their identity, distribution, abundance, habitat associations, and development during early life history. (Basic study material, larvae from plankton samples from *T. N. Gill* cruises, 1953-1954, is being supplemented by larvae obtained from subsequent cruises and other sources. Data from these studies will contribute to general distribution studies and to detailed investigations of selected species, genera, and families of fishes.) •In-house research.

Agency or institution. BCF Biological Laboratory, U.S. Department of the Interior, Brunswick, Ga. 31520

Investigator. Thomas W. McKenney (address same as above)

199 Fish population studies

By means of mathematical models and experimental laboratory populations of fish, determining the basic relations among yield (catch per unit time), fishing rate, population size, and the environment. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigator. Ralph P. Silliman, BCF Biological Laboratory, 2725 Montlake Boulevard East, Seattle, Wash. 98102

200 Fishery exploration and gear research (inland waters)

Defining, on a seasonal basis, the quantitative and qualitative distribution and availability of abundant underutilized species of freshwater fish such as alewife, bloater chubs, carp, freshwater drum, gizzard shad, goldeye, and suckers in the Great Lakes and in rivers and reservoirs; developing improved methods and equipment for fishing these multipurpose waters and commercial rearing ponds. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, 5 Research Drive, Ann Arbor, Mich. 48103

Investigators. M. R. Greenwood, A. Larsen, M. F. Boussu, J. E. Ellis, and E. W. Bowman (address same as above)
J. C. Hall and R. L. Gill, Rohwer, Ark. 71666
W. D. Handwork, Saugatuck, Mich. 49453
W. R. Nelson and J. A. Gable, Mobridge, S. Dak. 57601

201 Groundfish population dynamics

Determining relative abundance of groundfish, rates of fishing and natural mortality, and relation between sustainable yields and fishing effort. (Data are obtained from the commercial fishing fleet and from research vessel surveys. Mathematical models are utilized to provide sustainable yields as a function of fishing effort.) •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigator. Richard C. Hennemuth, BCF Biological Laboratory, Woods Hole, Mass. 02543

202 Ichthyological studies

Studying the morphology, taxonomy, and distribution of scombroid, gadoid, elasmobranch, argentinoid, and synentognath fishes, including those that may be prey, competitors, or predators of commercially important species. •In-house research.

Agency or institution. U.S. Department of the Interior, BCF Ichthyological Laboratory, U.S. National Museum, Smithsonian Institution, Washington, D.C. 20560

Investigators. Daniel M. Cohen, Bruce B. Collette, and Stewart Springer (address same as above)

203 Lobster biology and population dynamics

Studying the ecology, behavior, and population dynamics of inshore and offshore populations of lobsters to obtain information for optimum use and management; by means of serology, biochemistry, tagging, morphometrics, parasite fauna, and larval distribution, seeking to determine whether the two populations consist of two or more distinct geographic races; investigating factors in the environment that may influence the growth and abundance of lobsters. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Bernard E. Skud, George J. Ridgway, Richard Cooper, Joseph Uzmann, Walter Welch, and Kenneth Sherman; BCF Biological Laboratory, West Boothbay Harbor, Maine 04575

204 Menhaden biology and dynamics

With the general aim of providing a basis for proper management of menhaden fisheries in the Atlantic Ocean and the Gulf of Mexico, developing knowledge about menhaden biology and dynamics; seeking explanation of natural fluctuations in menhaden abundance; studying effect of changes in menhaden habitat on resources productivity; adding to our knowledge of when and where Atlantic and gulf manhaden spawn, the effects of extremes in environment on the survival of young menhaden, and the rate and pattern of movement of menhaden along the east coast. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Joseph H. Kutkuhn (population dynamics), Robert L. Dryfoos (tagging), Richard W. Lichtenheld (behavior and physiology), and John W. Rientjes (life history); BCF Biological Laboratory, Beaufort, N.C. 28516

205 Physical and biological oceanography of a luminous bay

Examining in detail the physical and biological oceanography of a luminous bay, Oyster Bay in Falmouth, Jamaica, West Indies, in which there exists, in persistently high concentrations, essentially a single species of tropical marine bioluminescent dinoflagellate, *Pyrodinium bahamense*, in the midst of persistently high concentrations of nonbioluminescent, photoautotrophic nannoplankton and ultraplankton; putting into practice the concept of self-contained, mobile laboratory trailers having such diverse functions as darkroom facilities, autoclaving, glassblowing, and high-speed centrifugation; developing instrumentation for the programmed, automated measurement and recording of a number of parameters, such as salinity, temperature, bioluminescent intensity, ambient light intensity, tide level, wind speed, and wind direction; developing instrumentation for water sampling, underwater spectrometers for ambient light spectral intensity distributions, and towable bioluminescence photometers for large-scale mapping of dinoflagellate concentrations; developing a consistent model for the complex flow patterns due to the interactions of wind, tide, low-salinity river water, bay topography, and *P. bahamanse* phototaxis; providing information on (1) nutrient levels and distributions, (2) populations of other planktonic algae and protozoa, (3) populations of zooplankton and copepods, and (4) distribution of aerobic and anaerobic bacteria. •Research supported by U.S. Atomic Energy Commission and Office of Naval Research, U.S. Department of the Navy.

Agency or institution. Merganthaler Laboratory for biology, The Johns Hopkins University, Baltimore, Md. 21218

Investigators. W. D. McElroy, H. H. Seliger, W. G. Fastie, and J. H. Carpenter (address same as above)

206 Pink and chum salmon research

Studying the environmental and biological factors that influence the abundance and growth of pink and chum salmon in Alaskan streams and estuaries; determining the

effects on salmon survival of too few or too many spawners; evaluating the effects on salmon abundance of interspecific competition for space and food; determining the effects of predators on salmon stocks; collecting fish throughout Alaska and analyzing tissues for chlorinated hydrocarbon pesticide residues; determining growth, estimating mortality, and discovering migration routes of juvenile pink salmon during their first summer in the sea; determining the effects of salinity and streambed gradient on survival of pink salmon eggs and fry; determining the physiological effects of varying water salinities on embryonic salmon development; developing methods of improving the freshwater environment to increase survival of pink and chum salmon eggs; evaluating the effect of the great Alaska earthquake on the production of salmon in intertidal spawning areas; simulating, with computers, the effects of fishing and oceanographic conditions on mortality and ocean migration route of pink salmon. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Theodore R. Merrell, Jr., Jack E. Bailey, Mary Barr, Robert J. Ellis, William R. Heard, John H. Helle, John W. Martin, Roy M. Martin, Chester R. Mattson, and Howard W. Sears; BCF Biological Laboratory, Box 155, Auke Bay, Alaska 99821

207 Radioactive pollution and physiological effects on marine organisms

Investigating the interactions of environmental factors, including ionizing radiation, on the physiology of estuarine organisms; studying, for example, effects of differences in salinity, temperature, pH, and total amount of zinc in the water on the concentration of zinc 65 from sea water by a community of oysters, clams, mud crabs, and scallops, and their sediment substrate; evaluating factorial analysis of variance to show possible interactions among environmental factors; determining the effects of the interactions of salinity, temperature, and radiation on the mortality, LD_{50}, and osmoregulation of euryhaline fish and invertebrates; using multiple regression analyses to derive equations describing the effects of all factors that have a significant effect on mortality at different intervals after exposure. •In-house research cooperative with U.S. Atomic Energy Commission.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Thomas W. Duke and Joseph W. Angelovic, BCF Radiobiological Laboratory, Beaufort, N.C. 28516

208 Restoration, propagation, and management of marine algae

Developing techniques for establishing kelp beds in barren areas by artificially "seeding" the sea floor with kelp spores; evaluating the effects of water turbulence and temperature, substrate roughness, light intensity, and spore concentration on success of seeding; extending techniques for raising giant kelp to other algal species and developing cultures of species tolerating or requiring warm temperatures. •Research supported by National Science Foundation.

Agency or institution. W. M. Keck Laboratory of Environmental Health Engineering, California Institute of Technology, Pasadena, Calif. 91109

Investigators. Wheeler J. North (address same as above) Michael Neushul, Jr., Department of Biology, University of California, Santa Barbara, Calif. 93106

209 Shellfish culture

Monitoring the shellfish potential of upper Chesapeake Bay and Chincoteague Bay and making recommendations on how to utilize this potential; studying and developing methods of shellfish culture in natural waters and man-made ponds; studying factors affecting the growth and survival of oysters and other shellfish found in natural environments or maintained in artificial environments. •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigator. William N. Shaw, BCF Biological Laboratory, Oxford, Md. 21654

210 Shellfish ecology and physiology

Studying the interaction of physical, chemical, and biological factors in estuarine areas, with emphasis on the ecology of commercial shellfish; studying the physiology of larval, juvenile, and adult stages of commercial shellfish and their associates; studying the ecology of artificial saltwater ponds as a basis for providing information for future management and cultural techniques in marine agriculture. •In-house research.

Agency or institution. BCF Biological Laboratory, U.S. Department of the Interior, Oxford, Md. 21654

Investigator. Robert W. Hanks (address same as above)

211 Shellfish mortality

Conducting long-range studies to determine causes of shellfish mortality that act directly or in concert with one another in natural, artificial, and controlled environments; where possible, translating research findings into recommendations to prevent, alleviate, eradicate, or control conditions that cause shellfish mortality. (Several disciplines are brought to bear on the study of diseases; they include protozoology, parasitology, microbiology, tissue culture, epizootiology, invertebrate pathology, immunology-serology, and physiology.) •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior. Washington, D.C. 20240

Investigators. Aaron Rosenfield (principal investigator), George E. Krantz, Haskell S. Tubiash, Thomas K. Sawyer, C. Austin Farley, John A. Couch, Martin W. Newman, Lucretia R. Buchanan; BCF Biological Laboratory, Oxford, Md. 21654

212 Shrimp biology and population dynamics

Developing a sound basis for managing shrimp resources by determining the size at which shrimp should be harvested to provide maximum yields and developing reliable methods for predicting shrimp abundance. (Determinations of optimum size are based on analyses

of commercial landing data and results from marking studies; shrimp abundance is believed to be controlled largely by environmental conditions affecting the survival of larvae.) •In-house research.

Agency or institution. Bureau of Commercial Fisheries, U.S. Department of the Interior, Washington, D.C. 20240

Investigators. Richard J. Berry, Richard A. Neal (population studies), and K. Neal Baxter (predictions); BCF Biological Laboratory, Fort Crockett, Building 302, Galveston, Tex. 77550

213 Surf clam biology and population dynamics

Investigating surf clam populations, with emphasis on abundance, recruitment, mortality, and sustained yield; using information obtained from studying the biology and ecology of the surf clam to create a theoretical model of the surf clam population in the Middle Atlantic Bight. •In-house research.

Agency or institution. BCF Biological Laboratory, U.S. Department of the Interior, Oxford, Md. 21654

Investigators. Robert M. Yancey and John W. Ropes (address same as above)

214 Systematic-ecologic studies of the marine biota of the Cape Cod region

Continuing long-range studies of whole organisms and their environments in relation to levels of biotic organization beyond the levels of the organisms concerned; directing major theoretical focus toward elucidation of systematic relationships, ecologic processes, and variation of estuarine and coastal biota. (Project includes a broad training program in organismic biology and a cooperative graduate program with Boston University.) •Research supported by Ford Foundation; National Science Foundation; Office of Naval Research, U.S. Department of the Navy; Whitehall Foundation of New York; National Institute of Dental Research, U.S. Department of Health, Education, and Welfare; and Grass Foundation of Boston.

Agency or institution. Marine Biological Laboratory, Woods Hole, Mass. 02543

Investigators. M. R. Carriker (principal investigator)
R. D. Turner, R. P. Higgins, and J.M. Reinhart (systematic investigations and the George M. Gray Museum)
D. K. Young (biotic census of Cape Cod Bay)
M. R. Carriker, R. D. Turner, and R. T. Wilce (marine flora and invertebrate fauna of New England)
J. R. Sears and R. T. Wilce (benthic marine algae in Woods Hole area)
F. E. Round (marine epiphytic diatoms of Cape Cod)
E. T. Moul (angiosperms of the marine fringe of Cape Cod)
W. R. Cobb (penetration mechanism of boring sponge Cliona)
K. W. Petersen (hydrozoa of east coast of the U.S.)
L. Bush (turbellaria of Cape Cod region)
W. D. Hummon (intertidal marine gastrotrichs from Woods Hole region)
R. P. Higgins (biology of the Kinorhyncha)
W. D. Hope (marine nematodes from the Cape Cod region)
T. J. M. Schopf (ectoprocta)
R. O. Brinkhurst (marine Oligochaeta)
J. L. Simon (reproductive biology and larvae of Cape Cod polychetes)
D. G. Cook (tubificid polychetes of Cape Cod)
C. P. Mangum (physiological ecology of Diopatra)
M. T. Ghiselin (higher classification of mollusks)
M. R. Carriker, H. H. Chauncey, M. U. Nylen, and P. Person (shell penetrating mechanism of boring gastropods)
B. A. Wade (New England nudibranchs)
W. C. Summers (life history and autecology of squid, *Loligo pealei)*
L. W. Pollock (marine tardigrada of Woods Hole region)
V. A. Zullo (classification of Balanomorpha)
A. Michael (amphipoda in Cape Cod)
E. L. Bousfield (Gammaridean Amphipoda of New England)
H. H. Plough (Ascidiacea of Atlantic continental shelf of North America)
R. H. Green and K. D. Hobson (biotic and abiotic factors regulating density of Gemma at Barnstable Harbor)
D. K. Young (nutrition of deposit-feeding fauna of a soft-bottom community)
R. H. Parker (benthic communities of Hadley Harbor)
J. B. Pearce (epibenthic mytilid populations and associated biota in Quicks Hole)
D. J. Zinn (interstitial microfauna of New England beaches)

215 Systematics and physiological ecology of Tunisian littoral communities

Studying systematics of Mediterranean shallow-water (eulittoral, sublittoral) organisms; developing instrumentation for measuring the microclimates (flow of water, light, oxygen, etc.) around selected benthic organisms of the Mediterranean Sea; measuring and recording these microclimates and determining the importance of various factors affecting the structure, well-being, and dynamics of the benthic communities; conducting field and laboratory experiments on the physiology and ecology of selected organisms. •In-house and foreign-grant research; in collaboration with Mediterranean Marine Sorting Center, Salambo, Tunisia, and Zoological Institute, University of Bari, Italy.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Klaus Ruetzler (address same as above)
Helmut Forstner, Department of Animal Physiology, University of Innsbruck, Austria
Ernst Kirsteuer, Department of Living Invertebrates, American Museum of Natural History, New York, N.Y. 10024

216 Systematics and zoogeography of the tropical blennioid fishes

Making monographic revisions of the genera of blennioid fishes; searching for and explaining zoogeographic patterns of tropical marine shore fish distribution; studying the relationships of the blennioid fish families within the group and between the group and the other perciform fishes. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Victor G. Springer (address same as above)

PM/PF

217 Ecological significance of organic release products of marine and freshwater animals

Studying the release rates of dissolved free amino acids and total dissolved organic matter by various dominant species of planktonic and benthic freshwater animals; determining mucus release rates for a variety of corals, jellyfish, and other mucus producers; determining molting rates of the benthic estuarine shrimp *Palaemonetes pugio;* comparing the loss of organic matter by these routes with the rate of oxidation of organic matter during respiration; attempting to estimate rates of energy flow via these pathways in natural marine and freshwater communities and investigating the use of these release products by other organisms. •Research supported by National Science Foundation.

Agency or institution. Department of Zoology, University of Georgia, Athens, Ga. 30601

Investigator. R. E. Johannes (address same as above)

PM/PP

218 Nutrient limitation and sources of nitrogen for marine primary production

Continuing research of 5 years' duration, using the heavy isotope of nitrogen, ^{15}N, to investigate the dynamics of nutrient-limited populations; measuring rates of nitrogen flow through the marine production system; establishing the significance of nitrogen fixation in adding new nitrogen to the sea in regions supporting nitrogen-fixing blooms of (for example) *Trichodesmium.* •Research supported by National Science Foundation.

Agency or institution. Department of Oceanography, University of Washington, Seattle, Wash. 98105

Investigator. Richard C. Dugdale (address same as above)

PM/EP

219 Eilat coral reef

Studying the coral reef at Eilat with particular reference to the diversity of corals in space and the behavioral properties of reef fishes in natural situations; testing the thesis that high species diversity is correlated with high ecological maturity, high complexity of interactions between species, and high community stability. •Research supported by Smithsonian Institution; cooperative with University of Tel Aviv.

Agency or institution. Department of Zoology, The University of Michigan, Ann Arbor, Mich. 48104

Investigators. Lawrence B. Slobodkin and Yosef Loya (address same as above)

PM/SB

220 Development of the genitalia of shrimp

Studying the development of the external genitalia of both sexes of the species and subspecies of commercial shrimp of the genus *Penaeus* from the western Atlantic, in the hope that knowledge thus gained will permit identification of juveniles at different stages of growth, which would aid in predicting yearly abundance; investigating the taxonomy and geographical and bathymetrical distribution of benthic penaeid shrimps along the continental shelf of the western Atlantic. •Research supported by U.S. Department of the Interior and National Science Foundation.

Agency or institution. Bureau of Commercial Fisheries Ichthyological Laboratory, U.S. National Museum, Washington, D.C. 20560

Investigator. Isabel C. Canet (address same as above)

UM

221 Biochemical-based breeding for high-protein grains

Undertaking investigations having as their ultimate objective the development of information that could lead to (1) identification of genes controlling the inheritance of enzymes and enzyme systems that are related to the production of protein in cereal grains (initial investigations will be confined largely to nitrate reductase), (2) selection of breeding material that has the genetic potential for enhanced production of high quality and quantity of protein in cereal grains, and (3) an understanding of how and when the plants metabolize nitrate—an understanding that would provide guidelines for managerial practices. •Research supported by Public Health Service, U.S. Department of Health, Education, and Welfare.

Agency or institution. Department of Agronomy, University of Illinois, Urbana, Ill. 61801

Investigators. R. H. Hageman, R. J. Lambert, and C.M. Brown (address same as above)

222 Biological control of tree-disease organisms

Conducting research intended to promote biological control of serious forest-tree disease organisms and to reduce pesticide hazards. •In-house and foreign-grant research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. James M. Trappe, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oreg. 97331 (research on tree root pathogens such as *Poria weirii* and their control by mycorrhizal fungi and other soil organisms) William A. Campbell, Forestry Sciences Laboratory, Carlton Street, Athens, Ga. 30601 (research on *Phytophthora cinnamomi,* the cause of littleleaf disease of southern pines)

Charles D. Leaphart, Forestry Sciences Laboratory, P.O. Box 469, Moscow, Idaho 83843 (research on *Tuberculina maxima*, which is widespread in the range of western white pine)
Richard T. Bingham, Forestry Sciences Laboratory, P.O. Box 469, Moscow, Idaho 83843 (research on genetic resistance of western white pine to blister rust)
Karol Manka, Institute of Plant Protection, Poznan, Poland (testing fungal isolates from forest soils for their effect on *Fomes annosus* and *Armillaria mellea)*

223 Biosystematics and phylogeny of the species of *Aphytis* (Hymenoptera:Aphelinidae) of the world

Using crossing tests and other techniques in biosystematic studies of living cultures for species delimitation, evaluation of within-species variation, delimitation of species groups, and phylogenetic evaluation and assessment of the status of evolution of uniparental species; conducting an in-depth comparative study of living material from as many species cultures as can be obtained; continuing studies of interspecific hybridization and reproductive isolation in order to help explain phylogenetic relationships. •Research supported by National Science Foundation.

Agency or institution. Department of Biological Control, College of Biological and Agriculture Sciences, University of California, Riverside, Calif. 92502

Investigator. Paul DeBach (address same as above)

224 Crop production in the Tropics

Evaluating U.S. crops under tropical conditions; collecting and evaluating tropical crops for potential use in Puerto Rico and in foreign tropical countries; developing improved lines of disease-resistant crops (germ plasm obtained through international cooperation is used in this work). •In-house research supported by Agricultural Research Service, U.S. Department of Agriculture.

Agency or institution. Federal Experiment Station, Box 70, Mayaguez, Puerto Rico 00708

Investigators. Murray H. Gaskins, Rodrigo Alconero, Franklin W. Marin, Frederick R. Miller, and Eric G. Stone (address same as above)

225 Cultural potential of plant species

Investigating geographic distribution, botanical nature, and use of plant species in relation to their cultural potential; studying the systematic relationship for alternate species useful in crop improvement and the development of new crops. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigator. Robert Perdue, Crops Research Division, ARS, Beltsville, Md. 20705

226 Development of soybean varieties resistant to soybean rust

Developing soybean varieties of good agronomic type with adequate resistance to soybean rust; searching existing soybean germ plasm for resistance to rust; determining whether there are races of the rust organism and whether there are varietal differences in resistance to different races. •In-house research.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigator. Richard L. Bernard, Crops Research Division, ARS, U.S. Regional Soybean Laboratory, Urbana, Ill. 61801

227 Ecological studies of grassland ecosystems

Conducting ecological studies involving species and communities of livestock ranges and wildlife habitats that typify diverse physical and biological situations (locations are listed under "Investigators," below); determining successional stages, competition responses, and environmental relations; conducting methodology and taxonomic studies for measurement and description of plant and vegetation attributes; testing principles of management aimed at bringing about maximum productivity of livestock ranges and wildlife habitats within the precepts of multiple use. •In-house research.

Agency or institution. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. Vinson L. Duvall, Alexandria Forestry Center, 2500 Shreveport Highway, Pineville, La. 71360 (Coastal Plain forests)
Hewlette S. Crawford, North Central Forest Experiment Station, New Agriculture Building, University of Missouri, Columbia, Mo. 65201 (temperate deciduous forests)
Wallace M. Johnson, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, Colo. 80521 (Montana forests and grasslands)
Dixie R. Smith, Forest Range and Watershed Laboratory, University Station, P.O. Box 3354, Laramie, Wyo. 82071 (Alpine grasslands)
Neil C. Frischknecht, Intermountain Forest and Range Experiment Station, 88 West 1st North, Provo, Utah 84601 (Great Basin desert shrub)
Walter F. Mueggler, Forestry Sciences Laboratory, Montana State University, Bozeman, Mont. 59715 (Montana forests and grasslands)

228 Factors governing plant radiosensitivity

Achieving a deeper understanding of mutation through the coordination of research relating to that process in a single multicellular system; identifying and studying the basic mechanisms by which physical and chemical mutagens act to induce genetic damage; acquiring new knowledge about the nature of induced mutations; using mutants in a variety of studies in plant science. •Research supported by U.S. Atomic Energy Commission.

Agency or institution. Department of Agronomy, Washington State University, Pullman, Wash. 99163

Investigators. Robert A. Nilan and Calvin F. Konzak (address same as above)
Thomas Bogyo, Information Science Program, Washington State University, Pullman, Wash. 99163

229 Incorporation of desirable height and maturity genes into alien sorghum stocks

Converting elite alien sorghum stocks to height and maturity genotypes that will increase their usefulness to U.S. agriculture. •In-house research supported by Agricultural Research Service, U.S. Department of Agriculture.

Agency or institution. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

Investigators. F. R. Miller, Federal Experiment Station, Mayaguez, Puerto Rico 00708

D. T. Rosenow, State Agricultural Experiment Station, Texas A & M University, Lubbock, Tex. 79401

K. F. Schertz, State Agricultural Experiment Station, Texas A & M University, College Station, Tex. 77843

230 Influence of growing conditions on relative amounts of individual proteins and on lysine content of wheat

Determining the influence of such factors as air temperature, soil temperature, maturation temperature, soil type, moisture supply, amount of light, fertilization, wavelength of light, daylength, and storage time on the protein profile of wheat and on the lysine content of wheat; learning how to produce predictable changes in the protein pattern and lysine content of wheats by environmental manipulation; establishing environmental conditions suitable for comparing the inherent lysine content of wheat varieties. •Research supported by the state of Washington.

Agency or institution. Department of Agricultural Chemistry, College of Agriculture, Washington State University, Pullman, Wash. 99163

Investigators. John M. Lawrence (address same as above)

R. E. Allan, W. L. Nelson, C. F. Konzak, and I.D. Teare; Department of Agronomy, College of Agriculture, Washington State University, Pullman, Wash. 99163

231 Maintaining and distributing germ plasm

Maintaining germ plasm in the Small Grains Collection (wheat, oats, barley, and rye); on request, distributing germ plasm to plant breeders throughout the world for evaluation as sources of genetic material; receiving, recording, and supplying information concerning the performance of 20,000 wheats and ryes, 10,000 barleys, and 9,000 oats. •In-house and foreign-grant research in Israel, Egypt, Pakistan, and Yugoslavia.

Agency or institution. Crops Research Division, Agricultural Research Service, Beltsville, Md. 20705

Investigator. Joseph C. Craddock, Jr. (address same as above)

232 Maintenance of genetic stocks

Continuing evaluation of the operation of established stock centers; where feasible, consolidating these centers as research interest in organisms changes; promoting the systematic and orderly flow of information concerning the location of genetic stocks; arranging for the preservation of germ plasm essential for genetic analysis and breeding when it is in danger of disappearing; providing "watch dog" activities to prevent the loss of significant genetic stocks upon the death of particular individuals; assisting in evaluating proposals concerned with genetic stocks prior to the submittal of such proposals to the National Science Foundation and the National Institutes of Health. •Project supported by National Science Foundation.

Agency or institution. Committee on the Maintenance of Genetic Stocks, Genetic Society of America, Biological Sciences Department, Dartmouth College, Hanover, N.H. 03755

Director. R. W. Barratt (address same as above)

233 Natural enemies of spider mites

Studying the potential of spider mite increase in chemically untreated and unfertilized plots as contrasted to that in plots receiving pesticide treatments and fertilizer components, singly and in combination; determining the role of pesticides in the destruction or inhibition of mite enemies and the capacities of the enemies to cope with the prey increase in its most fecund state, as well as at lower levels of power of increase; studying the role of edaphic and meteorologic factors relative to both spider mite increase and enemy response and efficiency; determining the nature and extent of numerical response in enemies to increasing density of prey mites at the single species level and collectively for a complex of enemies; evaluating the independent and combined impacts of several kinds of predators to establish whether their actions are "interfering" (and thus mutually nullifying) or supplemental. •Research supported by National Science Foundation.

Agency or institution. Division of Biological Control, Department of Entomology and Parasitology, University of California, Berkeley, Calif. 94720

Investigators. C. B. Huffaker, D. L. Flaherty, and J. E. Laing (address same as above)

234 Physiology of yield and management of sorghum in relation to genetic improvement

Investigating the physiology of yield in sorghum under optimal and suboptimal conditions; evaluating temperature and moisture stress tolerances of sorghum, millets, and corn; studying morphology as it relates to the physiology of sorghum; assessing the influence of microclimate on sorghum development and determining the optimal plant type for maximum production efficiency under a range of environments. •Research supported by Rockefeller Foundation.

Agency or institution. Nebraska Agricultural Experiment Station, University of Nebraska, Lincoln, Nebr. 68503

Investigators. Jerry D. Eastin (technical leader), M. D. Clegg, Jerry W. Maranville, C. Y. Sullivan, William Biggs, and R. C. Lommasson (address same as above)

235 Role of entomophagous insects in population regulation of armored scale insects (Homoptera: Diaspididae) in major world ecosystems

Studying the role of entomophagous insects in population

balance; discovering new natural enemies; exchanging beneficial biota internationally; evaluating the ecological impact of these biota on host populations; illustrating feasibility of biological control of pest insects; evaluating possibilities of decreasing environmental pollution from use of chemical pesticides and studying habitats in which scale insects are serious pests to learn what biotic regulatory factors are lacking or how those present are adversely affected by other factors. •Research supported by National Science Foundation.

Agency or institution. Department of Biological Control, College of Biological and Agricultural Sciences, University of California, Riverside, Calif. 92502

Investigator. Paul DeBach (address same as above)

236 Storage and retrieval of information on plant genetic resources

Establishing records on available plant genetic resources (wheat, barley, oats, beans) maintained at Washington State University as a basis for an interchange of materials with other stations in the United States and the world; investigating the practicality of computerized systems for storing, retrieving, and manipulating information on plant genetic resources used in plant breeding and related procedures. •Research supported by Washington State University.

Agency or institution. Agricultural Research Center, Washington State University, Pullman, Wash. 99163

Investigators. C. F. Konzak and T. P. Bogyo (address same as above)
S. M. Dietz, Regional Plant Introduction Station, ARS, USDA, Washington State University, Pullman, Wash. 99163

237 Tracer techniques for study of changes in wheat proteins during dough mixing and fermentation

Producing wheat with radioactive-labeled proteins with maximum activity in the several proteins; characterizing as to radioactivity and other significant properties, such as dye-binding capacity, the proteins or groups of proteins and separating them; studying changes in proteins during dough mixing and fermentation, using radioactivity as a tracer. •Research supported by state of Washington.

Agency or institution. Department of Agricultural Chemistry, College of Agriculture, Washington State University, Pullman, Wash. 99163

Investigators. John M. Lawrence and Hedwig Herrick (address same as above)

UM/HA

238 Catalog of arthropod-borne viruses of the world

Developing a method of cataloging and exchanging condensed information on the arthropod-borne viruses of the world, including information on (1) source and manner of isolation; (2) antigenic, physical, and chemical characteristics; (3) natural and experimental host range; (4) pathogenesis; (5) geographic distribution; and (6) observed frequency and symptomatology of human infection. (The catalog will include all viruses biologically transmitted by arthropods and actually or potentially infectious to man or animals. Distribution will be limited to laboratories or institutes engaged in research related to the isolation, classification, or natural behavior characteristics of arboviruses.) •Research supported by National Institute of Allergy and Infectious Diseases, U.S. Department of Health, Education, and Welfare.

Agency or institution. American Type Culture Collection, 12301 Parklawn Drive, Rockville, Md. 20852

Investigators. Trygve O. Berge and Richard M. Taylor (address same as above)

EP

239 Attraction behavior of European species of bark beetles

Studying attraction behavior of European species of bark beetles infesting Douglas-fir stands introduced into Czechoslovakia from the Pacific Northwest (U.S.); applying methods and equipment found successful in studying bark beetles in the U.S.; investigating the theory that host substances (e.g., resin, terpenes, and insect-produced pheromone) govern the process by which bark beetles are attracted to fir stands. •In-house research; cooperative with the Forest Research Institute, Zvolen, Czechoslovakia.

Agency or institution. Department of Entomology, Oregon State University, Corvallis, Oreg. 97331

Investigator. Julius A. Rudinsky (address same as above)

240 Daily and seasonal variation in spectral quality of solar radiation

Determining the influence of latitude and climatic conditions on the spectral quality of solar radiation; comparing results obtained at stations in Washington, D.C., and Jerusalem, Israel; determining the photochemical regulatory responses in plants under natural light conditions; measuring the quality and quantity of the light environment during daily and seasonal fluctuations; determining the amount and ratio of spectral components near sunrise and sunset (when biological clocks may be affected). •In-house and foreign-contract research.

Agency or institution. Radiation Biology Laboratory, Smithsonian Institution, Washington, D.C. 20560

Investigators. William H. Klein and Walter A. Shropshire (address same as above)
Harry Z. Tabor, National Physical Laboratory of Israel, Jerusalem, Israel

241 Extrarenal ionic regulation in the diamondback terrapin

Investigating the mechanism of active ion transport in three epithelial membranes (pharynx, cloaca, and cloacal bursae) and the salt gland of the brackish water diamondback terrapin; comparing extrarenal excretion rates of the

terrapin, sea snakes, marine and estuarine crocodiles, and the marine iguana. •Research supported by National Science Foundation.

Agency or institution. College of Science, Pennsylvania State University, University Park, Pa. 16802

Investigator. William A. Dunson (address same as above)

242 Ionic regulation in freshwater teleosts and its relation to environmental temperature

In general, investigating the physiology of thermal acclimation in freshwater fishes, with emphasis on the regulation of ionic metabolism; specifically, investigating (1) the capacity of representative local eurythermal and stenothermal species to regulate ionic metabolism over the whole of their zones of thermal tolerance, (2) the sequence of changes in water-electrolyte concentrations and distributions that follow thermal change and accompany acclimation to new temperatures, (3) the hypothesis that a measure of rates of thermal acclimation may be based on the time required for restabilization of the internal environment following alteration of the thermal environment, and (4) the compensatory changes in regulatory activities that accompany thermal acclimation. •Research supported by National Science Foundation.

Agency or institution. Department of Biology, Marquette University, Milwaukee, Wis. 53233

Investigator. Arthur H. Houston (address same as above)

243 Neotropical paleobotany

Analyzing Caribbean fossil microfloras from Mexico, Panama, and Puerto Rico to determine (1) reconstruction of Tertiary environments at selected sites within the Latin American biota, (2) paleoclimatic changes at these sites, and (3) elucidation of plant migrations in response to climatic changes; assessing the relation between the plant and animal communities of the eastern United States and those of the eastern escarpment of the Mexican Plateau in order to determine more accurately the time of origin of this biogeographic pattern of distribution. •Research supported by National Science Foundation.

Agency or institution. Department of Biological Sciences, Kent State University, Kent, Ohio 44240

Investigator. Alan K. Graham (address same as above)

244 Photosynthesis and respiration of antarctic lichens

Studying the ecological and physiological adaptations of lichens of Antarctica; determining the photosynthetic and respiratory rates of lichens in the field; correlating these rates with the microclimate of these organisms in their natural environment; comparing data on metabolic responses and microclimatic conditions of the Palmer Peninsula area to data obtained in the Cape Hallett area; relating the antarctic lichens to lichens in other parts of the world and comparing data on radiosensitivity of antarctic lichen-components to data already obtained. •Research supported by National Science Foundation.

Agency or institution. Department of Biology, Clark University, Worcester, Mass. 01610

Investigators. Theodore P. Gannutz (address same as above)

Vernon Ahmadjian, Department of Botany, University of Massachusetts, Amherst, Mass. 01003

SB

245 Alpine flora of Mexico and Guatemala

Preparing a taxonomic account of the alpine flora of Mexico and Guatemala; investigating ecological relations in the alpine vegetation; making a phytogeographical evaluation of the affinities and origins of the flora. •Research supported by National Science Foundation.

Agency or institution. Beal-Darlington Herbarium, Department of Botany and Plant Pathology, Michigan State University, East Lansing, Mich. 48823

Investigator. John H. Beaman (address same as above)

245 Biosystematic and zoogeographic studies of neotropical water beetles

Conducting an exhaustive survey of the water beetle fauna; studying their ecology and life history; collecting, rearing, and describing their larval forms. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Paul J. Spangler (address same as above)

247 Biosystematic study of the Lygaeidae of South Africa (Hemiptera; Heteroptera)

Studying the ecology and biology of the South African Lygaeidae; investigating the reproductive ecology of the vegetation of the South African ecosystems inhabited by large populations of mixed species feeding on seeds; evaluating information concerning questions of species diversity (whether related to ancient climax habitats or tropical conditions per se) the relation between niche size and species diversity, the relation of habitat permanence to dispersal patterns, life history adaptations, and host specificity. •Research supported by National Science Foundation.

Agency or institution. Department of Biology, Texas A & M University, College Station, Tex. 77843

Investigator. Merrill Henry Sweet (address same as above)

248 Comparative embryology and floral anatomy of the olyroid-bambusoid grasses

Undertaking a systematic-anatomic study of the olyroid-bambusoid genera of grasses and some of their allies; studying the general morphology; analyzing anatomical characters; studying the embryology, cytology, and other aspects of available material; undertaking a critical review of the literature and revising information on olyroid-bambusoid grasses. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Thomas R. Soderstrom and Cleofé E. Calderón (address same as above)
Naresh Chandra and V. Puri, Meerut College, Meerut, India

249 Cytotaxonomic studies in the Tenrecoidea

Karyotyping all the available taxa of this superfamily of insectivores endemic to the island of Madagascar; exploring taxonomic, biochemical, and other approaches helpful to understanding phylogeny and speciation; studying and collecting specimens for zoological museums (specimens to include at least five males and five females for each taxa). •Research supported by National Science Foundation.

Agency or institution. The Johns Hopkins University, Baltimore, Md. 21205

Investigators. Digamber S. Borgaonkar, Division of Medical Genetics, Department of Medicine, The Johns Hopkins University School of Medicine, Baltimore, Md. 21205
Edwin Gould, Laboratory of Comparative Behavior, Department of Mental Hygiene, The Johns Hopkins University School of Hygiene and Public Health, Baltimore, Md. 21205

250 Flora of Ceylon

Performing field work and herbarium study necessary for revising, family by family, Trimen's handbook to the flora of Ceylon; preparing manuscripts embodying these revisions for a school flora of Ceylon. •In-house research; cooperative with the University of Ceylon, the Ceylon Department of Agriculture, and the Royal Botanic Gardens, Peradeniya.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. F. Raymond Fosberg (address same as above)
B. A. Abeywickrama, University of Ceylon, Peradeniya, Ceylon
J. E. L. Pieris, Department of Agriculture, Peradeniya, Ceylon
D. M. A. Jayaweera, Royal Botanic Gardens, Peradeniya, Ceylon

251 Flora of Micronesia

Studying the taxonomy and ecology of Micronesian and Polynesian vascular plants; preparing descriptive floras of Micronesia and the Marquesas (to be published at a later date) and reviewing the nomenclature of many pantropical plants to bring their names into accord with the International Code of Botanical Nomenclature. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. F. Raymond Fosberg and M. H. Sachet (address same as above)

252 Flora of North America

Preparing a concise diagnostic treatise on "flora" of all the vascular plants of the continental United States, Canada, and Greenland. (The flora will be designed to serve both as an identification manual for plants collected anywhere within the regions named and as a systematic conspectus of the North America flora, not only for theoretical work in taxonomy, ecology, and phytogeography, but also for practical reference in biology, wildlife management, forestry, and agriculture in general; it will include dichotomous keys, brief diagnoses, habitat and distribution summaries, pertinent synonymy, chromosome numbers, and other significant biological observations.) •Research supported by Smithsonian Institution.

Agency or institution. American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016

Investigator. John Olive (address same as above)

253 Flora of the state of Catarina, Brazil

Preparing and publishing in Portuguese and in English an illustrated flora of the state of Catarina, Brazil, consisting of between three and four thousand species ranging from flora of a coastal rain forest to that of a temperate plateau. •In-house research; in collaboration with Padre Raulino Retiz, Director of the Herbário "Barbosa Rodrigues" of Santa Catarina.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Lyman B. Smith (address same as above)

254 Plant survey of the Planalto do Brasil

Organizing and carrying out a program of botanical exploration in the Planalto do Brasil for the systematic reconnaissance of the plants of that region and for collecting specimens; in each of the areas selected for study, producing a plant inventory and an account of ecological factors (e.g., soil type, topography, exposure, and vegetation type); collecting cytological materials as appropriate structures appear in the proper developmental stage; collecting flowers and buds for palynological study; collecting stems, leaves, flowers, and fruits for morphological and anatomical study; collecting wood samples for anatomical study; supplying materials for monographs that will become part of *Flora Neotropica.* (The program is intended to stimulate interest in the plants of the Planalto and to draw upon the competence of individuals and institutions throughout the botanical community.) •Research supported by National Science Foundation.

Agency or institution. The New York Botanical Garden, Bronx, N.Y. 10458. (Collaborating institutions: Universidade de Brasilia, Ministerio da Agricultura, Instituto Agronomico do Norte, and Fundaçao Brasil Central.)

Investigator. Howard S. Irwin, Jr. (address same as above)

255 Preliminary identification manual for African mammals

Producing a Smithsonian Institution manual to provide a preliminary guide to the taxonomy of African mammals, to summarize the present state of our taxonomic knowledge, and to show where further taxonomic knowledge is most urgently needed. (In collaboration with the IBP

National Committee of the Republic of South Africa.) •Contract research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. J. Meester, University of Pretoria, Pretoria, Republic of South Africa (editor)
J. du P. Bothma, Department of Nature Conservation, Transvaal, South Africa (order Hyracoidea)
G. B. Corbet, British Museum (Natural History), London, England (order Macroscelidea)
E. Amtmann, Anatomical Institute, Köln-Lindenthal, Bonn, Germany (family Sciuridae)
P. Best, South African Museum, Cape Town, South Africa (order Cetacea)
W. F. H. Ansell, Department of Game and Fisheries, Kalomo, Zambia (order Proboscidea, order Perissodactyla, order Artiodactyla)
C. G. Coetzee, State Museum, Windhoek, South West Africa (order Carnivora)
A. W. Gentry, Sidcup, Kent, England (genus *Gazella)*
F. Petter, Museum National d'Histoire, Naturello, Paris, France (order Lagomorpha and family Gerbillidae)
R. W. Hayman, British Museum (Natural History), London, England (order Chiroptera)
X. Misonne, Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (order Rodentia)
D. H. S. Davis, Medical Ecology Centre, Johannesburg, South Africa (genera *Tatera* and *Aethomys*)
G. de Graff, University of Pretoria, Pretoria, South Africa (family Bathyergidae)
P. Dandelot, Museum National d'Histoire Naturelle, Paris, France (order Primates)

256 Relationships of American and Asiatic Hydrobiidae

Continuing the study of snails of the freshwater family Hydrobiidae to clarify anatomic and zoogeographic relationships, a study that involves examining the gross anatomy of as many unstudied species as possible. •In-house research; in collaboration with Dr. Antonia Garcia-Cubas, University of Mexico.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Joseph P.E. Morrison (address same as above)

257 Social behavior and communication in the tenrecs of Madagascar

Studying the evolution of communication systems and social tolerance of the species *Hemicentetes;* establishing those aspects of ecological adaptation that favor the evolution of simple social systems and resolving the role of learning in the determination of information content. •Research supported by National Science Foundation.

Agency or institution. School of Hygiene and Public Health. The Johns Hopkins University, Baltimore, Md. 21205

Investigators. Edwin Gould (address same as above)
John F. Eisenberg, National Zoological Park, Washington, D.C. 20009

258 Systematic and biogeographic studies of aquatic and semiaquatic organisms in northern Mexico

Conducting studies in the basin of Cuatro Cienegas, Coahuila, Mexico, in an attempt to define systematic relationships and ecology of the unique aquatic biota; in other work on fishes, molluscs, aquatic plants, and crustaceans, in this and adjacent areas of northern Mexico, gathering biogeographic information on local and regional basis. •Research supported by National Science Foundation.

Agency or institution. Department of Zoology, Arizona State University, Tempe, Ariz. 85281

Investigator. W. L. Minckley (address same as above)

259 Systematics and evolution of fishes endemic to the Mesa Central of Mexico

Analyzing systematically the fishes endemic to the Mesa Central of Mexico; determining the limits of specific variation and so defining the valid species: determining, if possible, the position of the family Goodeidae within the order Cyprinodontoidei; determining the relationship of the genus *Algansea* to other North American Cyprinidae; determining the relationships of the genera *Falcularius* and *Xystrosus* to the other Cyprinids of the Mesa Central; making a coherent and reasonable statement concerning the evolution of fishes endemic to the Mesa Central. •Research supported by National Science Foundation.

Agency or institution. Department of Environmental Biology, University of Utah, Salt Lake City, Utah 84112

Investigator. Clyde D. Barbour (address same as above)

260 Systematics of freshwater and brackish-water mussels

Studying the anatomical material of the 15 generic groups of freshwater and brackish-water mussels for which the gross anatomy is largely undescribed, with emphasis on those endemic to Mexico and Central America; collecting new material so that all the freshwater Naiades may be permanently allocated systematically on the basis of their anatomy. •In-house research; in collaboration with Dr. Antonio Garcia-Cubas, University of Mexico.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Joseph P. E. Morrison (address same as above)

261 Systematics of neotropical mammals

Providing a center for the study of systematics, variation, relationships, and distribution of neotropical mammals, primarily rodents; promoting research activity to revise the taxa; resolving contradictions in identification of species, nomenclature, and limits of variation. •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Charles O. Handley, Jr., and Ronald H. Pine (address same as above)

262 Systematics, zoogeography, and plant relationships of montane phytophagous Coleoptera and Lepidoptera in New Guinea

Investigating the systematics, zoogeography, evolution, and synecology of the phytophagous (and certain other) beetles and certain Lepidoptera of montane areas of New Guinea; attempting to correlate host-plant relationships and immature stages of the insects; rationalizing the evolution of food preferences in relation to phylogeny and zoogeography and determining the preliminary general ecology of the montane forests. •Research supported by National Science Foundation.

Agency or institution. Entomology Department, Bernice P. Bishop Museum, Honolulu, Hawaii 96819

Investigators. J. Linsley Gressitt, J. J. H. Szent-Ivany, Josef Sedlacek, and N. L. H. Krauss (address same as above)

263 Taxonomy and distribution of Neotropical Leguminosae

Conducting taxonomic studies in the Leguminosae, especially those of the New World tropics, in an effort to add to our knowledge of the taxonomy and geographic distribution of a large and important plant family. (Monographic treatments are used, as needed, to identify the taxa and clarify the nomenclature within certain faboid genera; floristic treatments are used to provide descriptions and keys for identification of the legumes of particular areas, such as Mexico and the Galápagos Islands.) •In-house research.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Velva E. Rudd (address same as above)

264 Vegetation in Ceylon

Determining the origin and dynamics of high-altitude grasslands, with emphasis on soil-vegetation relationships; investigating the paleoecology of Ceylonese vegetation; preparing descriptions of sites for research under the International Biological Program; studying animal-vegetation interactions. •In-house research; cooperative with the University of Hawaii and the University of Ceylon.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. F. Raymond Fosberg (address same as above)

Dieter Mueller-Dombois, Department of Botany, University of Hawaii, Honolulu, Hawaii

B. A. Abeywickrama, University of Ceylon, Peradeniya, Ceylon

SB/HA

265 Southeast Asia mosquito project

Studying and monographing the mosquito fauna of Southeast Asia; receiving and examining specimens and building up a reference collection (placing some emphasis on genera and groups that are of public health importance). •Research supported by U.S. Department of the Army.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigators. Botha de Meillon, C. John Lane, Yiau-Min Huang, E. L. Peyton, and Sunthorn Sirivanakarn (address same as above)

J. Bonne-Wepster, 81, Reynier Vinkeleskade, Amsterdam-South, The Netherlands

J. M. Klein, Institut Pasteur du Cambodge, Pnom-Penh, B. P. 174, Cambodia

Kenneth L. Knight, Department of Entomology, North Carolina State University, P.O. Box 5214, Raleigh, N.C. 27607

Peter F. Mattingly, Department of Entomology, British Museum, Cromwell Road, London, S. W. 7, England

Shivaji Ramalingam, Department of Parasitology, Faculty of Medicine, University of Malaya, Pantai Valley, Kuala Lumpur, Malaysia

Thomas J. Zavortink, Department of Zoology, University of California, Los Angeles, Calif. 90024

SB/UM

266 Storage and retrieval system for biological and geological data

Developing a program for utilizing an information system in national and international natural history museums; establishing better means of communication between museums, universities, and other centers of research; developing proper interfaces between the system and subject-oriented information systems; testing a general data storage and retrieval system, with emphasis on three subject areas representing different degrees of sophistication of knowledge: oceanic birds, marine crustacea, and marine rocks. •Research supported by U.S. Department of Health, Education, and Welfare.

Agency or institution. Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Investigator. Donald F. Squires (address same as above)

Appendix A

Additional Information Concerning

INTEGRATED RESEARCH PROGRAMS

(Human Adaptability Group)

INTERNATIONAL STUDY OF ESKIMOS

In 1968 a team of scientists, assisted by a number of graduate students, began a short-term multidisciplinary study of the Eskimo community at Wainwright, Alaska. The main objective is to determine how the human-breeding isolate in this community has perpetuated itself in the face of meager resources and a harsh climate.

The Director is Frederick A. Milan, Department of Anthropology, University of Wisconsin, Madison, Wis. 53706.

Following are the scientists engaged in the study, with their areas of responsibility:

Geneology and demography. Frederick A. Milan (see above).

Genetic markers. R. H. Osborne, University of Wisconsin, and R. W. Meier, Indiana University.

Growth and development. W. S. Laughlin, J. R. Cameron, and R. B. Mazess, University of Wisconsin; and A. A. Dahlberg, J. Mayhall, and R. Owen, University of Chicago.

Epidemiology. F. Pauls, Wisconsin State Laboratory of Hygiene; C. Dotter, University of Oregon; and C. Crumpton, University of Wisconsin.

Environmental physiology. D. W. Rennie and R. Fitts, State University of New York at Buffalo; R. Shephard, University of Toronto, Canada; and P. G. di Prampero, University of Milan, Italy.

Detailed information will be collected on the biological and social interactions within the community and between the community and the physical environment. This information will be analyzed in an approach to understanding the general processes of human adaptability. The analysis will be facilitated by access to data collected on three other Eskimo communities by the Canadian, Danish, and French research workers (see section II of this report).

The following projects are integrated with the Wainwright study:

Dento-cranial studies of a genetic isolate of Eskimos

As a part of a long-term, comprehensive, multidisciplinary study of the Wainwright Eskimo community, establishing norms for dental health, growth, and orthodontic treatment. •Research supported by National Institute of Dental Research, U.S. Department of Health, Education, and Welfare.

Investigators. William S. Laughlin, Department of Anthropology, University of Wisconsin, Madison, Wis. 53706 A. A. Dahlberg, Mrs. A. A. Dahlberg, J. Mayhall, and Robert Owen, University of Chicago, Chicago, Ill. 60601

Health, performance, genetics, and ecology of Eskimos

Studying the ways in which an Eskimo community perpetuates itself in a harsh environment; following a multidisciplinary approach that includes (1) general health and physical fitness, with particular attention to the cardiovascular system and serum epidemiology; (2) child growth and human performance, including aspects of morphology such as dentition, size and form of the body at different ages, and bone mineral content; (3) genetics, including population genetics, the breeding structure, and demographic factors; and (4) ecology, including an ecological-ethnological survey. •Research supported by (1) Office of Scientific Research, U.S. Department of the Air Force; (2) Office of Naval Research, U.S. Department of the Navy; and (3) Wenner-Gren Foundation.

Investigators. William S. Laughlin and Frederick A. Milan, Department of Anthropology, University of Wisconsin, Madison, Wis. 53706

Physical fitness and work performance of Alaskan Eskimos

Studying physical fitness, work capacity, and respiratory function of the Eskimos of Wainwright, Alaska; measuring maximal and submaximal oxygen consumption under exercise, and heart rate; determining muscle strength in selected groups; measuring maximum endurance in severe work; measuring lung volumes, including residual volume and maximal breathing capacity. •Research supported by Smithsonian Institution.

Investigators. Donald W. Rennie, Department of Physiology, State University of New York at Buffalo, Buffalo, N.Y. 14214

Roy Shephard, Department of Physiological Hygiene, School of Hygiene, University of Toronto, Toronto, Canada

P. G. di Prampero, Institute of Human Physiology, University of Milan, Milan, Italy

POPULATION GENETICS OF THE AMERICAN INDIAN

Status: This program is funded by the U.S. Atomic Energy Commission, and research is under way.

Director. James V. Neel, Department of Human Genetics, University of Michigan Medical School, Ann Arbor, Mich. 48104

Investigators. Francisco Salzano, Universidade do Rio Grande do Sul, Porto Alegre, Brazil

Miguel Layrisse, Instituto Venezolano de Investigaciones Cientificas, Venezuela

William J. Schull, The University of Michigan, Ann Arbor, Mich. 48104

The South American Indian presents a number of unusual challenges and opportunities to the student of population genetics. Three of these are discussed below.

1. The South American Indian population is the only major population whose time and place of arrival into a large unoccupied area can be dated with some accuracy. Having this information about the Indians' arrival, we can study the tempo of human evolution by carefully characterizing, and later comparing, the genetic characteristics of Indian subpopulations that have remained unmixed with Negro and Caucasian populations.

New genetic "marker" systems provide measuring devices to supplement the more established yardsticks of physical anthropology, dermatoglyphics, and blood types. Furthermore, recently developed statistical techniques and computer programs provide the means of combining a variety of measurements into generalized "distance" functions and deriving probably phylogenetic relationships between various groups. Thus, the time is propitious for expanded approaches to problems of evolution in the American Indian, with the probability that the results will have transfer value for human evolution in general.

2. A number of Indian tribes in South America are still pursuing an essentially pre-Colombian mode of existence, deriving their subsistence by hunting, gathering, and simple agriculture and possessing a very simple technology. This mode was the norm of human existence until a very recent period in human evolution. Studies on tribes at this level should provide a great deal of insight into the population structure of man during his evolution. They should also provide insight into the important factors in natural selection under primitive conditions. Opportunities of this type are rapidly disappearing; ours is probably the last generation to have the opportunity to investigate human ecology at this cultural level.

3. In a few generations, many Indian populations will be required to make the transition from a near-Stone Age type of existence to modern civilization. To the extent that biological adjustments (and selection) are involved in this transition, the Indian may thus telescope adjustments that in Caucasian populations occurred over a much longer period. The "diseases of civilization" may emerge in him in an especially acute form, thus presenting not only a practical problem but also an unusual opportunity to gain insight into these diseases. The emergence of diabetes mellitus and cholelithiasis as major medical problems in the Indian of the southwestern United States is an example of this situation.

A study of the Yanomama (Waica) of southern Venezuela and northern Brazil is in progress. The study characteristically falls into two phases. The first is a multidisciplinary attempt to describe the tribe in appropriate detail, this attempt involving the cultural anthropologist, linguist, physical anthropologist, physician, dentist, and geneticist, whose efforts in the field are backed by extensive laboratory studies on blood, urine, saliva, and stool specimens. The second phase is an effort to focus on specific questions arising from the first. Thus, in the case of the Yanomama, interest is focused on such specific questions as the following:

- What opportunities do the fission-fusion pattern of village formation provide for stochastic events to determine gene frequencies, and what are the implications of this for genetic differences between tribes?
- What can be learned about gene flow between primitive tribes by observing results of both peaceful and warlike contacts between the Yanomama and the Makiritare (who, fortunately for the investigation, possess two polymorphisms not found in the Yanomama)?
- Will the subdivisions of the tribe as determined genetically correspond to those determined linguistically, and if not, can we use the linguistic yardstick to validate genetic taxonomy?
- How do we explain the relatively high frequency of congenital heart disease among the Yanomama?
- Are antibodies acquired by the active disease processes observed in more advanced cultures? Or are they acquired as a result of prolonged nursing and high maternal gamma globulin? Does the ecology of many diseases differ at this level? If so, what does this imply for natural selection?
- What opportunities for rapid genetic change have been introduced by polygyny (and the intense competition for women), and what by contrast are the implications of the present mating structure of human populations?

A strong computer program, both for processing data and for simulating populations, is an integral part of the study of population genetics of the South American Indian. Computer models of the types of populations under study, and of contemporary populations, are nearing completion.

BIOLOGY OF HUMAN POPULATIONS AT HIGH ALTITUDES

Status: A research proposal has been submitted to a granting agency for funding. A management proposal for

coordination of the overall program is in the final draft stage.

Co-Directors. Paul T. Baker, Department of Anthropology, Pennsylvania State University, University Park, Pa. 16802

Robert F. Grover, Cardiovascular Pulmonary Research Laboratory, University of Colorado Medical Center, Denver, Colo. 80220

The objectives of this program are to study the distribution and nature of the variables in man's adaptive capacity at high terrestrial altitudes and to define the processes of adaptation.

United States participation will be concentrated in the Western Hemisphere, and collaboration between scientists in Latin America and the United States will be emphasized.

As stated in section II of this report, three populations will be studied—two in the Andes of South America and one in the Rocky Mountains of North America.

One of the Andean populations and the Rocky Mountain population are living at intermediate altitudes. The people in the Rocky Mountains are of European ancestry. They lack any of the racial or genetic elements of acclimatization that people of the Andes may inherit. They have lived at high altitude for many years, but their ancestors originated in low altitude.

Except for a shorter period of residence at high altitude, the population at Leadville, Colo., in the Rocky Mountains, is comparable with the Andean population. Leadville has a population of about 10,000. The community was founded about 100 years ago; hence, the oldest families have been there for only four generations.

The incidence of adverse reactions to altitude is relatively high at Leadville. Such reactions include hypoventilation, polycythemia, severe pulmonary hypertension, and pulmonary edema. The high incidence suggests that there has not been sufficient time (only four generations) for "natural selection" to remove from the population those persons who do not adapt well. In the Andean population, the incidence of adverse reactions to altitude is much lower. Presumably, persons who are unable to adjust have been eliminated.

The third study is concerned with a population living at a considerably higher altitude in the Andes.

Methods will be established to define adaptive mechanisms specifically in terms of cardiovascular adjustments and central nervous system implications. Experimental animal work will be designed, and the results will be applied to the development of definitions of mechanisms in man. The physiologic status of persons living at high altitude will be differentiated from that of lowlanders.

The pathophysiologic consequences of acute, chronic, and lifelong exposure to the added stresses of altitude will be defined, and the significance of the findings will be evaluated in comparable populations of different cultures.

Responsibility for the Leadville study has been assigned to the following:

Co-Principal Investigators. Robert F. Grover, University of Colorado Medical Center, Denver, Colo. 80220

John Rankin, University of Wisconsin, Madison, Wis. 53706

Investigators. Jerome A. Dempsey, William G. Reddan, and Marvin L. Birnbaum; University of Wisconsin Medical Center, Madison, Wis. 53706

NUTRITIONAL ADAPTATION TO THE ENVIRONMENT

Status. Statements on sources of support are included in descriptions of individual research projects. A management proposal for coordination of research and support of working conferences is in preparation.

Co-Directors. C. Glen King, Institute of Nutrition Sciences, Columbia University Medical Center, 562 West 168th Street, New York, N.Y. 10032

O. Lee Kline, American Institute of Nutrition, 9650 Rockville Pike, Bethesda, Md. 20014

The program on nutritional adaptation to the environment is designed to guide mankind toward successful adaptation to environmental changes that relate to food. Attempts to establish limits of adaptability and to improve food resources will be accelerated by controlled studies with animals and by recognition of genetic variability.

The program has three subprograms: Tropical and Subtropical Ecology, Temperate Ecology, and Arctic Ecology. Each subprogram will be coordinated with ecological studies.

Tropical and Subtropical Ecology

Protein deficiency is a serious health problem in Latin America and in large sections of Africa, the Middle East, India, Pakistan, and Southeast Asia.

Descriptions of research projects follow.

Development of food from cellulosic wastes

Using a semibatch, chemical-microbrial process to convert cellulosic wastes to single-cell protein; determining the nutritional value and digestibility of the product; conducting psychological studies on acceptability of the material as a food supplement. •Research supported by Louisiana State University.

Investigators. C. D. Callihan, Ralph W. Pike, F. A. Pryor, V. R. Srinivasan, and S. P. Yang, Louisiana State University, Baton Rouge, La. 70803

Development of soy-based foods of high nutritive value

Developing soy-based foods of high nutritive value, with particular reference to needs of infants and children in the Philippines and other Far Eastern countries; at Cornell University, investigating processing variables to determine their effects on cost, flavor, and nutritional value; in the Philippines, carrying out other aspects of the research, such as selecting varieties, modifying the process to fit local conditions, and determining the need for fortification with minerals and vitamins. •Research supported by Agency for International Development, in collaboration with College of Agriculture, University of the Philippines, Los Banos, Republic of the Philippines, and with Food and Nutrition Research Center, National Institutes of Science and Technology, Manila, Philippines.

Directors. W. B. Robinson, Department of Food Science and Technology, New York State Agricultural Experiment Station, Cornell University, Geneva, N.Y. 14456

Keith H. Steinkraus, University of the Philippines, College, Laguna, Philippines

Effect of variation in caloric intake on DNA, RNA, and protein content of the fetal brain

Studying cellular events occurring during normal and abnormal growth; quantitating organ growth in terms of increase in cell number versus increase in cell size by serially measuring DNA, RNA, and protein content of tissues; accelerating and decelerating cell division during the period of hyperplasia by varying caloric intake to determine effects on cell division during malnutrition and the possibility of rehabilitation in the developing fetal brain. •Research supported by Nutrition Foundation, The Pan American Sanitary Bureau, and National Foundation-March of Dimes in collaboration with Department of Pediatrics, Hospital Roberto del Rio, University of Chile, Santiago, Chile.

Investigators. Myron Winick, Department of Pediatrics, Cornell Medical College, 1300 York Avenue, New York, N.Y. 10021

Julio Meneghello and Pedro Rosso, Department of Pediatrics, Hospital Roberto del Rio, Santiago, Chile

Irving Fish, Department of Pediatrics, Cornell Medical College, 1300 York Avenue, New York, N.Y. 10021

Effects of malnutrition in early life

Studying the effects of early malnutrition on subsequent physical and mental development in experimental animals; establishing conditions for measuring permanent retardation of learning behavior; examining changes in brain development from the normal as measured by biochemical and microscopic alterations during very early life. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigator. Richard H. Barnes, Graduate School of Nutrition, Cornell University, Ithaca, N.Y. 14850

Endemic goiter in Latin America

Studying the prevention of goiter in an area of severe endemic goiter by depot-iodination, and determining whether prevention by this means would also prevent cretinism, mental retardation, and endemic deafmutism existing in the area. •Research supported by U.S. Department of Health, Education, and Welfare; Mental Retardation Foundation; and Pan American Health Organization.

Investigators. John B. Stanbury, Department of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Mass. 02139

Rodrigo Fierro, Ignacio Ramirez, and Eduardo Estrella, Escuela Politecnica Nacional, Departmento de Radioisotopos, Apartado 2759, Quito, Ecuador

Leslie J. DeGroot, Department of Medicine, University of Chicago, 650 East 59th Street, Chicago, Ill. 60637

Philip Dodge, Department of Pediatrics, Washington University School of Medicine, 500 South Kingshighway, St. Louis, Mo. 63110

Eduardo Pretell, Instituto de Investigaciones de la Altura, Departmento de Endocrinologia, Apartado 6083, Lima, Peru

Andries Querido, Dukzigt Hospital, Dr. Molewaterplein 41, Rotterdam, Holland

Evaluation of fish protein concentrate

Testing a group of preschool children for the nutritional effectiveness of fish protein concentrate in processed foods; formulating foods with high-protein materials available in Chile. •Research supported by Agency for International Development, in cooperation with Department of Pediatrics and Biochemistry, School of Medicine, University of Chile, Santiago, Chile.

Investigators. C. O. Chichester, Department of Food Science and Technology, University of California, Davis, Calif. 95616

Fernando Mönckenberg, Department of Pediatrics and Biochemistry, School of Medicine, University of Chile, Santiago, Chile

Food composition table for use in the Far East

Compiling data on foods produced, processed, and prepared for consumption in the Far East and in Southeast Asia; determining the representative values of specific nutrients of these foods and publishing them as a comprehensive food table that can be readily translated into the languages of these regions. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigators. W. T. Wu Leung and Ritva Butrum, Health Services and Mental Health Administration, U.S. Department of Health, Education, and Welfare, 9000 Rockville Pike, Bethesda, Md. 20014

Hair root morphology and protein synthesis in disease

Studying hair follicles as a means for determining the response of protein synthesis to disease—particularly, the response to protein-calorie malnutrition; developing a dermatological model to determine changes in protein synthesis that occur in controlled experiments involving reduction of protein in human diets; using this model to compare changes that occur in hair roots and shafts of persons suffering from the two forms of protein-calorie malnutrition. •Research supported by University of California, Berkeley.

Investigators. Robert B. Bradfield, Department of Nutritional Sciences, University of California, Berkeley, Calif. 94720

D. B. Jelliffe, Department of Nutrition, University of the West Indies, Mona Post Office, Jamaica

Improved methods of extracting and utilizing plant proteins

Improving methods of extracting from commonly available plant sources proteins of high nutritive value that have the aroma, color, and flavor acceptable for formulating new foods; working on bean proteins at Cornell University and on coconut proteins in the Philippines. •Research supported by Cooperative State Research Service, U.S. Department of Agriculture, in collaboration with College of Agriculture, University of the Philippines.

Investigators. Keith H. Steinkraus, College of Agriculture, University of the Philippines, College, Laguna, Philippines

L. Ross Hackler and Walter F. Wilkens, New York State Agricultural Experiment Station, Cornell University, Geneva, N.Y. 14456

Increased protein supplies through peanut improvement

Developing genotypes and management practices for increased peanut production in the United States and India; exchanging germ plasm and research data to expedite progress in peanut research; identifying the ways in which environment affects protein content and other economic characteristics of peanuts. •In-house and foreign-grant research by Agricultural Research Service, U.S. Department of Agriculture.

Investigator. W. K. Bailey, Crops Research Division, ARS, Beltsville, Md. 20705

Indigenous foods for preschool children in developing countries

Reviewing the practices followed in feeding preschool children in specific environments in Thailand; developing fully nutritious, acceptable, and economical foods that can be produced in village-scale processing plants from indigenous raw materials and commodities containing plant and fish protein concentrate. •Research supported by AIMS International Corporation.

Investigators. Ahimud Kramer, John Kagan, R. C. Wiley, and Ben Gera, Department of Horticulture, University of Maryland, College Park, Md. 20742

Amara Bhumiratana, Preserved Foods Organization, Bangkok, Thailand

Influence of specific nutritional deficiency on the genetic expression of anemia

Determining human response in the form of preferential synthesis among multiple hemoglobins to a specific environmental stress (nutritional deficiency). •Research supported by U.S. Department of Health, Education, and Welfare; The Research Corporation; and Medical Research Council (United Kingdom).

Investigators. John F. Bertles, St. Luke's Hospital Center, Amsterdam Avenue at 114th Street, New York, N.Y. 10025

Paul F. A. Milner, Pathology Department, University of the West Indies, Kingston, Jamaica

Malnutrition in the Middle East

Supplementing laboratory, clinical, and field studies in the United Arab Republic with parallel methodologic and experimental nutritional investigations at Vanderbilt University; investigating anemias associated with protein-calorie malnutrition; studying the endocrinologic and metabolic definition of the syndrome of dwarfism, infantilism, and zinc deficiency; investigating nutrition in relation to parasitism, with emphasis on loss of minerals and trace elements. •Research supported by U.S. Department of Health, Education, and Welfare, in cooperation with U.S. Navy Medical Research Unit 3, Cairo, Egypt.

Investigators. William J. Darby, Division of Nutrition, Vanderbilt University, Nashville, Tenn. 37203

William N. Pearson, Department of Biochemistry, Vanderbilt University, Nashville, Tenn. 37203

Multiple etiology of nutritional anemias of Thailand

Studying, in both children and adults, the multiple etiology of nutritional anemias in Chiengmai, Thailand; evaluating nutritional status with regard to amino acids, iron, copper, folic acid, riboflavin, vitamin B_{12}, and alpha-tocopherol and studying the hematologic and biochemical responses to sequential therapy with these agents. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigators. Robert E. Olson, Max N. Horwitt, Jo Ann Whitaker, Charles H. Tan, and David Morehead, St. Louis University School of Medicine, 1402 South Grand Boulevard, Saint Louis, Mo. 63104

Mycotoxin contamination of food and foodstuffs in Southeast Asia

Determining the frequency and extent of aflatoxin contamination in feeds, foods, and foodstuffs in Thailand and neighboring countries; searching for previously unrecognized mycotoxins and identifying the toxin-producing fungi involved; identifying the conditions under which invasion by fungi occurs. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigators. G. N. Wogan and R. C. Shank, Department of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Mass. 02139

C. M. Christensen, Department of Plant Pathology, University of Minnesota, Minneapolis, Minn. 55812

Natth Bhamarapravati, University of Medical Sciences, Bangkok, Thailand

Nutrition and infections in India

Studying nutritional status, illnesses, and growth in children of lower socioeconomic groups in Punjab villages of India by comparing results of (1) complete medical care and diet supplements, (2) diet supplements alone, and (3) medical care alone. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigators. Carl E. Taylor and William A. Reinke, School of Hygiene and Public Health, The Johns Hopkins University, 615 North Wolfe Street, Baltimore, Md. 21205

Cecille Desweemer (Field Director), Hari Shankar, and I. S. Uberoi, Narangwal Village, Ludhiana District, Punjab, India

P. S. Venkatachalam and Col. B. L. Taneja, Indian Council of Medical Research, Ansari Nagar, Post Box 494, New Delhi, India

Nutrition research in Indonesia and Thailand

Studying problems of malnutrition in selected areas of Indonesia and Thailand; comparing a control population with people in other villages who have been furnished food supplements for preschool children and pregnant mothers; determining the relation between malnutrition and prevalent diseases. •Research supported by U.S. Department of Health, Education, and Welfare, in cooperation with the Indonesian and Thailand National Committees for the IBP.

Investigators. Paul Gyorgy, University of Pennsylvania, Philadelphia General Hospital, Philadelphia, Pa. 19104

H. E. Sauberlich, Chemistry Division, U.S. Army Medical Research Laboratory, Denver, Colo. 80240

Aree Valyasevi, SEATO Medical Research Laboratory, Bangkok, Thailand

Amorn Nondasuta, Nutrition Division, University of Public Health, Bangkok, Thailand
Dradjat D. Prawirenagara, School of Public Health, National University of Indonesia, Jakarta, Indonesia

Nutritional anemia in Southeast Asia

Studying nutritional anemia in Southeast Asia to determine its frequency and causes; defining appropriate public health measures; establishing facilities for assaying serum samples. •Research supported by National Institute of Arthritis and Metabolic Diseases, U.S. Department of Health, Education, and Welfare, in collaboration with medical school laboratories in Japan, Korea, Taiwan, Hong Kong, the Philippines, South Vietnam, Cambodia, Singapore, Indonesia, Burma, and India.

Investigator. Victor Herbert, The Mount Sinai School of Medicine, 100th Street at Fifth Avenue, New York, N.Y. 10029

Nutritional studies in Puerto Rico

Evaluating the nutritional status of rural populations and that of urban and suburban groups in Puerto Rico; conducting, throughout the island, a survey to obtain clinical, biochemical, dietary, and socioeconomic data; correlating findings with other health and environmental factors. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigators. Nelson A. Fernandez, Jose C. Burgos, and Conrado F. Asenjo; Department of Biochemistry and Nutrition, School of Medicine, University of Puerto Rico, San Juan, Puerto Rico 00905

Relationship of diet to the performance of the combat soldier

Determining the point at which reduction of caloric intake produced unacceptable loss of mental and physical performance of men on maneuvers in a jungle environment; measuring decrement of performance, body composition changes, and water and nitrogen balances during 10 days of reduced caloric intake; testing the best nutrient composition of available compact rations; measuring the fluid intake of subjects on modern-day garrison rations or on high intakes of salt and protein (combat) rations; investigating the handling of large salt and nitrogen loads by the kidneys in a hot and humid environment. •Research supported by U.S. Army Medical Research and Development Command, Department of Defense.

Investigators. C. Frank Consolazio, H. E. Sauberlich, H. L. Johnson, and H. J. Krzywicki; U.S. Army Medical Research and Nutrition Laboratory, Fitzsimons General Hospital, Denver, Colo. 80240

Role of trace metals in growth retardation

Studying the role of dietary zinc and other trace metals in the metabolic, hematologic, endocrinologic, and other effects noted in dwarfed individuals. •Research supported by U.S. Department of Defense (ARPA) and Veterans Administration.

Investigators. James A. Halsted, Office of Research and Education, Veterans Administration Hospital, Washington, D.C. 20422

James C. Smith, Trace Element Research Laboratory, Veterans Administration Hospital, Washington, D.C. 20422

Temperate Ecology

Good-quality protein foods are abundant in the United States, Canada, Western Europe, and other countries in the Temperate Zone. Nevertheless, research is needed to improve the food produced for our own people and for export. Genetic research to improve the protein quality and yield of cereal foods, and research on all other types of potential natural sources of protein, must continue.

Most of the nutrition research dealing with problems in the Temperate Zone is relevant to tropical countries also. However, the investigations described here relate primarily to local problems and, in general, are conducted in the United States.

Diet and fat metabolism

Conducting nutritional studies to obtain a better understanding of the effects of dietary, genetic, hormonal, and environmental factors on the absorption, transport, biosynthesis, and degradation of lipids in animals and man. (Included are studies of diet variations in proportions of protein, fat, and carbohydrates; quality and quantity of protein; type and quantity of fat; intake of monosaccharides and polysaccharides; and ingestion of food additives with detergent properties.) •In-house research by Agricultural Research Service, U.S. Department of Agriculture.

Investigators. Mildred Adams and Duane A. Benton, Human Nutrition Research Division, Agricultural Research Service, Beltsville, Md. 20705

Experimental scurvy in man

Inducing a deficiency of ascorbic acid in experimental subjects and (by labeling with carbon-14) estimating total ascorbic acid pool size, rate of depletion, minimal requirements, and relation between symptoms of scurvy and the levels of vitamin in the body; relating the amounts of ascorbic acid needed to replace the body pool to physiologic function and to metabolites in blood and urine. •Research supported by U.S. Army Medical Research and Development Command, Department of Defense.

Investigator. Robert E. Hodges, Department of Internal Medicine, University Hospitals, University of Iowa, Iowa City, Iowa 52240

Human iodine requirements and substances in foods that affect thyroid function

Studying patterns of iodine metabolism and magnitude of iodine stores in a population with a long history of thyroid deficiency, distribution and chemical nature of goitrogens in selected vegetables, naturally occurring factors in soybeans that depress thyroid function, and metabolic effects of adding foods treated with bromide fumigants to diets adequate and marginal in iodine. •In-house and foreign-grant research by Agricultural Research Service, U.S. Department of Agriculture, in cooperation with India, Japan, and Poland.

Investigators. Ruth M. Leverton, Mildred Adams, and Duane A. Benton, Human Nutrition Research Division, Agricultural Research Service, Beltsville, Md. 20705

Nutritional status of preschool children in the United States

Analyzing, from a selected sample of preschool children, nutritional experiences throughout life, food consumption for a 3-day period, medical history, and physical examination, including blood and urine analyses; developing a program for electronic analysis of the data (socioeconomic, nutrient, clinical, and laboratory). •Research supported by U.S. Department of Health, Education, and Welfare.

Investigator. George M. Owen, Department of Pediatrics, Children's Hospital, The Ohio State University, Columbus, Ohio 43205

Nutritional value of wheat and wheat products

Determining the content of nutrients in wheat and wheat products, the effect of processing on the nutrient content, and the nutritional value of wheat in human diets. •In-house research of Agricultural Research Service, U.S. Department of Agriculture.

Investigators. W. A. Gortner and E. W. Toepfer, Human Nutrition Research Division, Agricultural Research Service, Beltsville, Md. 20705

Nutritive factors in the immunological process

With the aim of clarifying the role of vitamins in immunological responses, investigating antibody synthesis at the cellular level in experimental animals; determining the role of ascorbic acid in antibody synthesis; studying the role of lymphocytes in delayed hypersensitivity and the effects of vitamin deficiencies on the synthesis of different types of RNA in cells. •Research supported by U.S. Department of Health, Education, and Welfare.

Investigator. A. E. Axelrod, Biochemistry Department, School of Medicine, University of Pittsburgh, Pittsburgh, Pa. 15213

Protein value of plant foods

Determining the composition and protein value of selected foods of plant origin and evaluating their nutritional quality when used as supplements to low-protein diets or as formulated protein-rich mixtures. •In-house and foreign-grant research by Agricultural Research Service, U.S. Department of Agriculture, in cooperation with India and Japan.

Investigators. Ruth M. Leverton, Mildred Adams, June Kelsay, and E. W. Toepfer, Human Nutrition Research Division, Agricultural Research Service, Beltsville, Md. 20705

Relationship of dietary deficiency and impairment of mental and somatic development

Determining the effects of early deficiencies of total amino N and specific amino acids on the somatic and mental development of laboratory animals, and analyzing the role of intestinal microflora in these deficiencies and in the resulting sequelae with the help of gnotobiotic techniques; determining minimal requirement for optimum growth of total amino N and certain specific amino acids in an otherwise balanced amino acid mixture. •Research supported by National Institutes of Health, U.S. Department of Health, Education, and Welfare.

Investigators. Bernard S. Wostmann, J. R. Pleasants, and B. S. Reddy, Department of Microbiology, Lobund Laboratory, University of Notre Dame, Notre Dame, Ind. 46556

D. C. Anderson, Department of Psychology, Lobund Laboratory, University of Notre Dame, Notre Dame, Ind. 46556

Vitamin B_6 metabolism in man

Seeking more definitive methods of assessing the vitamin B_6 nutriture of women of childbearing age; observing the effect of a vitamin B_6 depletion in women on a number of biochemical parameters. •Research supported by University of Wisconsin.

Investigator. Hellen Linkswiler, Department of Nutritional Sciences, College of Agriculture and Life Sciences, University of Wisconsin, Madison, Wis. 53706

Arctic Ecology

The subprogram on arctic ecology is sponsored jointly by the United States and Canada and will be concerned with a series of Eskimo communities. It will consist of the following phases:

- Clinical examinations for signs of specific deficiencies (serum iron, hemoglobin, serum proteins, blood levels of vitamin C, folic acid, vitamin B_{12}, and serum lipids).
- Estimation of caloric intake by major food types and seasonal variations (dietary histories, diet analyses, 24-hour urinary nitrogen, and excretion).
- Use and management of local food sources, distribution of food in the community, and type of food brought into the community.

The subprogram is being prepared by H. E. Sauberlich, U.S. Army Medical Research and Nutrition Laboratory, Fitzsimons General Hospital, Denver, Colo. 80240, and G. H. Beaton, University of Toronto, Toronto, Canada. Preliminary steps in the preparation are supported by the Medical Research and Development Command, U.S. Department of the Army.

ECOLOGY OF MIGRANT PEOPLES

Status. A plan for management and coordination of the program on ecology of migrant peoples is under review. Work has been initiated on a limited scale, and proposals for detailed research have been submitted to a granting agency for funding.

Director. Demitri B. Shimkin, Department of Anthropology and Geography, University of Illinois, Urbana, Ill. 61801

Co-Director. To be appointed

In this program an effort will be made to improve understanding of the nature, extent, and mechanisms of human adaptability to urban and industrialized environ-

ments. The method will be to examine the changes in biological and behavioral characteristics associated with the movement of socioculturally and genetically defined populations from rural to urban environments.

A further goal is to determine the effects of sociocultural and biological variance on the source populations. Here, the method will be to experimentally control selected variables (e.g., diet) and to examine counterflows (e.g., suburbanization).

An initial pilot phase of the program will be concerned with families in Holmes County, Mississippi. It is planned to survey the families of children in the Head Start program—a total of about 2,000 persons. Data will be collected on diet, occupation, income, housing, family structure, education, and mental health. An effort will be made to determine whether the improved diet, care, and education provided children in the Head Start program can be associated with improvements in mental and physical health and in school performance.

The Holmes County study will include a household survey of the entire county. Health, economic, and social conditions will be investigated.

Families who migrate from Holmes County will be reinterviewed to get data on migration patterns and the success or failure of migration as measured by effects on diet, health, family structure, fertility rates, and mental health. Kenrad R. Nelson, M.D., Department of Preventive Medicine and Community Health, University of Illinois Medical Center, Chicago, Ill., and Edward Eckenfels, Department of Social Services, Presbyterian-St. Luke's Hospital, Chicago Medical Center, Chicago, Ill., are in charge of the Mississippi-Illinois segment in Chicago.

Two preliminary studies are under way. One is concerned with the practice of midwifery and infant mortality in the source area of Holmes County; the other is a demographic survey of Holmes County.

This work will be coordinated with parallel studies in other parts of the country.

Investigators are as follows:

Demitri B. Shimkin, Department of Anthropology and Geography, University of Illinois, Urbana, Ill. 61801

Mark Lepper, M.D., Presbyterian-St. Luke's Hospital, Chicago Medical Center, Chicago, Ill. 60612

Henry Lorenzi, Department of Anthropology and Geography, University of Illinois, Urbana, Ill. 61801

Kenrad R. Nelson, M.D., Department of Preventive Medicine and Community Health, University of Illinois Medical Center, Chicago, Ill. 60612

Edward Eckenfels, Department of Social Services, Presbyterian-St. Luke's Hospital, Chicago Medical Center, Chicago, Ill. 60612

Bernice Montgomery, Milton-Olive III Memorial Program for Children, 402 Fifth Street, Lexington, Miss. 39095

Appendix B

Additional Information Concerning

INTEGRATED RESEARCH PROGRAMS

(Environmental Management Group)

ANALYSIS OF ECOSYSTEMS

Status. The central part of this program is supported by grants from the National Science Foundation and by a contract with North American Rockwell Corporation.

Director. Frederick E. Smith, School of Natural Resources, Department of Wildlife and Fisheries, The University of Michigan, Ann Arbor, Mich. 48104

Coordinator. John A. Kadlec (address same as above)

Director of Planning and Analysis. Robert H. Ellis, Traveller's Research, Inc., Hartford, Conn. 06103

Director of Remote Sensing. Donald S. Lowe, Department of Optical Sensors and Applied Physics, The University of Michigan, Ann Arbor, Mich. 48104

An understanding of major ecological processes can be found in a comparative study of ecosystems that have developed in very different situations. Hence, systems in six major biomes—grasslands, deciduous forests, coniferous forests, desert, tundra, and tropical forests—will be studied.

Within each biome, several sites will be studied *comprehensively*, with the aim of sampling a broad range of conditions, and at least one site will be studied *intensively*. All components of each system will be studied, and all processes will be evaluated in relation to other variables.

Synthesis of information will be a major research activity, ranking with the intensive and comprehensive field studies. The synthesis will begin with data from the several states of one system in the intensive study, continue with data from system variants in the comprehensive study, and conclude with data from the markedly different systems in different biomes.

Synthesis will be supported by a staff of planning and analysis experts in each biome. Models of ecosystems will be developed that incorporate the data, and an effort will be made to view the system as a whole. This process will begin at once and will continue for the life of the program. (At first, existing data will be used.)

About 300 scientists will participate in the total program, each having responsibility for a well-defined research project in his area of interest. In addition, research opportunities will be available for graduate assistants.

The Program Director and the Coordinator are responsible for research organization and coordination of studies in the six biomes, program projects, and program services. Plans are being developed for applying remote sensing techniques to the biome studies.

Statements on the biome studies follow. Each biome study constitutes a subprogram.

Grasslands Biome

Status. This subprogram is supported by grants from the National Science Foundation and the U.S. Atomic Energy Commission to Colorado State University, Fort Collins. Support for investigators will be by contract from the university.

Director and Principal Investigator. George M. Van Dyne, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colo. 80521

Pawnee Site Research Director. Donald A. Jameson (address same as above)

An important part of the grasslands subprogram—the comprehensive network project—is still being developed. This project will consist of integrated, comparable studies in a variety of North American grassland types. George M. Van Dyne is acting coordinator. A full-time coordinator is being sought.

Analysis of structure and function of grassland ecosystems will be carried out initially in four areas: site

development and construction; synthesis and review; initial research; and planning, analysis, and modeling.

Site Development and Construction

A major function of this work will be to delineate clearly the research areas on the Pawnee site in northeastern Colorado. Work completed or partly completed includes broad-scale soil and topographic surveying; securing adequate aerial-photo coverage; locating microwatersheds and installing runoff collection apparatus on half of the microwatersheds, installing neutron probe access tubes, etc.; and developing the instrumentation for micrometeorological facilities. The field headquarters site has been located, electrical and telephone communications have been installed, and water has been developed. Construction of buildings has been delayed because of funding problems.

Synthesis and Review

About 30 investigators are developing a review and synthesis of information about grassland ecosystems, particularly those in North America, and are interpreting this information as it relates to the Pawnee site and the comprehensive network program. At the end of 1968 the work was about half complete.

The results will be edited into a comprehensive document on grassland ecosystems. Personnel in the modeling projects will participate in order to transmit their findings and to obtain necessary data, parameters, and variances.

Ralph L. Dix, Botany Department, Colorado State University, is responsible for developing the information synthesis project. Persons who are participating in it are as follows:

R. G. Beidleman, Department of Zoology, Colorado College, Colorado Springs, Colo. 80903

A. C. Everson (Range Science Department), Charles Terwilliger, Jr. (Range Science Department), George Post (Fishery and Wildlife Biology Department), R. T. Ward (Department of Biology and Plant Pathology), and L. D. Miller (Department of Watershed Resources), Colorado State University, Fort Collins, Colo. 80521

B. O. Thomas, Biological Science Department, Colorado State College, Greeley, Colo. 80631

G. W. Tomanek, Biological Science Department, Fort Hays Kansas State College, Hays, Kans. 67601

F. A. Glover and J. E. Gross, Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Washington, D.C. 20240

Jerry Kline, Argonne National Laboratory, U.S. Atomic Energy Commission, 9700 South Cass Ave., Argonne, Ill. 60439

H. D. Blocker, Department of Entomology, Kansas State University, Manhattan, Kans. 66502

D. D. Collins, Botany and Microbiology Department, Montana State University, Bozeman, Mont. 59715

R. D. Pieper, Animal, Range, and Wildlife Sciences, New Mexico State University, Las Cruces, N. Mex. 88001

W. C. Whitman, Department of Natural Science, North Dakota State University, Fargo, N. Dak. 58102

J. W. LaVelle, Biology Department, Southern Colorado State College, Pueblo, Colo. 81001

R. E. Bement, F. E. Clark, and D. N. Hyder, Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C. 20250

J. K. Lewis, Animal Science Department, South Dakota State University, Brookings, S. Dak. 57006

O. H. Paris, Department of Zoology, University of California, Berkeley, Calif. 94720

M. L. Shubert, Biology Department, University of Denver, Denver, Colo. 80200

P. G. Risser, Botany Department, University of Oklahoma, Norman, Okla. 73069

D. F. Burzlaff, Agronomy Department, University of Nebraska, Lincoln, Nebr. 68500

H. G. Fisser (Plant Science Division), D. H. Knight (Botany Department), and R. W. Weeks (Department of Electrical Engineering), University of Wyoming, Laramie, Wyo. 82070

Initial Research

Eleven areas of research have been designated for the program on analysis of ecosystems; climatology, hydrology, meteorology, photosynthesis, herbage dynamics, large consumers, diets and small animals, grassland birds, insects, decomposers, and soils and nitrogen cycle.

The initial research projects that have been initiated are summarized below. The summaries are grouped according to the areas of research with which the projects are identified.

The initial projects were selected because of their criticality to the total ecosystem study. The first year was devoted to developing field techniques, refining instrumentation, and making preliminary measurements of parameters for the systems model.

Climatology

Investigation of climatic controls of grassland ecosystems

Summarizing and analyzing climatic information on the Pawnee National Grassland; evaluating the synoptic and mesoscale controls of the region's climate; modeling the relationships between the natural vegetation, soil, and climate of the grassland biome.

Investigator. W. E. Marlatt, Atmospheric Science Department, Colorado State University, Fort Collins, Colo. 80521

Hydrology

Precipitation-runoff-erosion relationships

Analyzing data from several microwatersheds instrumented for precipitation, runoff, sediment yield, and water quality; modeling the hydrologic process to demonstrate operation of the system; predicting runoff and erosion losses under varying conditions.

Investigator. W. D. Striffler, Recreation and Watershed Resources Management, Colorado State University, Fort Collins, Colo. 80521

Meteorology

Meteorological characteristics of the shortgrass system

Determining parameters by using measured rainfall and factors such as slope and measured outflow; taking continuous measurements of net radiation, solar radiation, albedo, soil heat flow, soil temperature profile, and latent heat flux; compiling a computer program to determine parameters and developing a model describing the ecosystem.

Investigators. C. F. Becker and R. D. Burman, Agricultural Engineering Section, University of Wyoming, Laramie, Wyo. 82070

Photosynthesis

Photosynthesis rate of plants of the plains grasslands

Measuring photosynthesis rates under a variety of field conditions; comparing with rates measured under controlled conditions in growth chambers; obtaining phenological and immediate effects of various environmental factors.

Investigators. W. H. Moir, Range Science Department, Colorado State University, Fort Collins, Colo. 80521
W. R. Buss, Biology Department, Colorado State College, Greeley, Colo. 80631

Herbage Dynamics

Changes in biomass of primary producers

Studying the seasonal and annual changes of aboveground and below-ground herbage biomass; identifying as far as possible the species level in areas that have been subjected to varying degrees of grazing since 1938; analyzing samples for water, energy, nitrogen, phosphorous, and carbon; sampling at selected periods of high and low vegetative growth.

Investigator. P. L. Sims, Colorado Agricultural Experiment Station, Eastern Colorado Range Station, Akron, Colo. 80270

Relationship of plant patterns to environmental processes

Developing instrumentation for measuring plant locations; establishing permanent plots for evaluation of vegetative patterns; evaluating plant pattern differences as influenced by natural and induced changes in environmental characteristics on these patterns.

Investigator. H. G. Fisser, Plant Science Division, University of Wyoming, Laramie, Wyo. 82070

Relationships between ecosystem functioning and the structural-functional features of plants

Determining whether plant structure and function can be used for indicating levels of productivity in grassland; relating plant structure and function to water movement in the grassland; developing indices based on plant structure and function and testing in the field.

Investigator. D. H. Knight, Botany Department, University of Wyoming, Laramie, Wyo. 82070

Large Consumers

Use and partitioning of water by cattle

Investigating the use of drinking-water tracers for determining total water movement through, and its partitioning by, cattle.

Investigators. D. N. Hyder and R. E. Bement, Agricultural Research Service, USDA, Fort Collins, Colo. 80521

Determining cattle and sheep diet in the grassland ecosystem

Collecting samples of the diet of cattle and sheep equipped with esophageal fistulae; studying diets for chemical and botanical composition; relating diet variability to the level of herbivory, climatic influences, and seasonal influences; comparing intake with that of wild herbivores; comparing domestic and wild herbivores for efficiency of energy and nutrient utilization.

Investigator. R. W. Rice, Animal Science Department, University of Wyoming, Laramie, Wyo. 82070

Energy and nutrient flow through the pronghorn antelope

Surveying diet constituents by examining rumen contents; determining digestive capacity by in vitro digestion, and stored nutrients by body composition analyses; paralleling these field studies with similar work on goats.

Investigators. J. G. Nagy and K. L. Knox, Colorado State University, Fort Collins, Colo. 80521

Diets and Small Animals

Diets and energy relations of small wild herbivores

Determining the seasonal diets and preferences of black-tailed prairie dogs, black-tailed jackrabbits, white-tailed jackrabbits, and audubon cottontails; determining the gross energy and nutritional content of the stomach contents in all seasons for the four herbivores.

Investigator. R. M. Hansen, College of Forestry, Colorado State University, Fort Collins, Colo. 80521

Grassland Birds

Feeding ecology of the lark bunting

Investigating the ecology of the lark bunting in the grasslands with respect to its position in the food web and energy flow; determining period of occupancy, population and distribution, foods eaten, phenology of plant foods, phenology of invertebrates, energy content of food sources, and energy flow.

Investigator. P. H. Baldwin, Zoology Department, Colorado State University, Fort Collins, Colo. 80521

Bioenergetics of grassland birds

Studying energy balance of selected species of grassland birds; determining energy contents of foods and excreta; analyzing caloric value contributed to other trophic levels of the ecosystem; determining energy values and computing energy estimates of respiration, production, and total energy flow through the birds of the grassland.

Investigator. R. A. Ryder, Fishery and Wildlife Biology Department, Colorado State University, Fort Collins, Colo. 80521

Insects

Effect of insect parasites and predators on grass-feeding insects

Identifying the grass-feeding insects in the area; ascertaining the insect parasites and predators present and their relationships with each other and with their grass-feeding hosts; deriving quantitative data for an energy-flow study.

Investigator. R. J. Lavigne, Plant Science Division, University of Wyoming, Laramie, Wyo. 82070

Grassland orthoptera

Ascertaining the role of grasshoppers in the ecosystem by taxonomic identification of the orthopteran fauna, estima-

tion of population densities and their dynamics, and determination of amount and kind of food consumed.

Investigator. D. H. Van Horn, Biology Department, University of Colorado, Colorado Springs, Colo. 80900

Arthropod survey and insects affecting seed structures

Collecting, mounting, and identifying arthropod fauna of the grasslands biome; measuring populations; determining the effect of populations of different sizes and equating their consumption of the primary production to that of other consumers; investigating microclimatic factors as determiners of insect behavior by use of remote-sensing devices within and outside canopies of host plants; adapting data for computer use.

Investigator. T. O. Thatcher, Entomology Department, Colorado State University, Fort Collins, Colo. 80521

Decomposers

Microbial biomass of the soil

Determining quantitative characterization of actinomycetes, bacteria, fungi, and algae in the grassland ecosystem; developing chemical and enzymatic techniques for determining microbial biomass; measuring the flow of carbon and energy through the soil ecosystem affected by microorganisms.

Investigator. K. G. Doxtader, Agronomy Department, Colorado State University, Fort Collins, Colo. 80521

Soil microfungi in the grassland ecosystem

Surveying the saprophytic soil microfungi in the grassland study area; determining the population characteristics and compositional variation; correlating data with other variables in the ecosystem.

Investigator. Martha Christensen, Botany Department, University of Wyoming, Laramie, Wyo. 82070

Bacterial ecology in grasslands

Investigating nutritional requirements and biochemical activities of the bacterial flora involved in nitrogen and carbon cycling; studying sequential development of the bacteria during decomposition of the native vegetation, including seasonal variations, interactions between microbial groups, and the effect of bacterial wastes on plant productivity.

Investigator. J. V. Mayeux, Microbiology Department, Colorado State University, Fort Collins, Colo. 80521

Soils and Nitrogen Cycle

Nitrogen budgets of grassland ecosystems

Characterizing the present nitrogen status as affected by past management of the soils on the Pawnee site; determining the nitrogen added by precipitation, the amount of nitrogen input by fixing organisms, and nitrogen loss due to biological denitrification and to evolution of nitrogen oxides; determining the extent to which grass plants conserve nitrogen for following year's growth by translocation to the root system as the plant matures; characterizing soils on the microwatersheds.

Investigators. J. O. Reuss and W. T. Franklin, Agronomy Department, Colorado State University, Fort Collins, Colo. 80521

Planning, Analysis, and Modeling

This activity includes (1) initial organization and coordination of the workshops and their results; (2) liaison with grassland projects in Canada and Mexico; and (3) liaison with grassland projects elsewhere in the world.

Investigators work closely with the groups in modeling and analysis at the biome level and interact with certain aspects of other U.S./IBP integrated research programs.

Modeling studies include working with the synthesis project to develop sets of differential equations that, in total, will make up the system's initial models and describe the flow of energy or nutrients from compartment to compartment of the grassland ecosystem. Biometrical, operations-research, and systems-analysis procedures are utilized.

A major function is to evaluate continually the results of research. A tentative mechanism is being developed for coding, tabulating, and analyzing data from the 11 initial research areas as well as from the synthesis project. This system will be tested as a forerunner of the major information processing and retrieval system to be utilized in the program.

Deciduous Forest Biome

A plan for the deciduous forest biome subprogram has been completed, and a proposal for management and coordination of the study has been submitted to a granting agency for funding. The Director is Stanley I. Auerbach, Radiation Ecology Section, Health Physics Division, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn. 37830. (The Oak Ridge National Laboratory is operated by the Union Carbide Corporation for the U.S. Atomic Energy Commission.)

Members of the Coordinating Committee for research on this biome are Stanley I. Auerbach, Oak Ridge National Laboratory; N. L. Clesceri, Rensselaer Polytechnic Institute, Troy, N.Y. 12180; F. G. Goff, University of Missouri, Columbia, Mo. 65201; Helmut Leith, University of North Carolina, Chapel Hill, N.C. 27514; Orie Loucks, University of Wisconsin, Madison, Wis. 53706; Steve Stephenson, Michigan State University, East Lansing, Mich. 48823; Karl Wenger, U.S. Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250; and E. C. Williams, Jr., Wabash College, Crawfordsville, Ind. 47933.

The proposed research will lay the foundations for an analytical approach to the study of deciduous forest ecosystems. It will include (1) comparison and synthesis of recent advances in environmental and ecosystem modeling (in collaboration with Travelers Research Center), (2) initiation of research on a biome-wide basis intended to bring together existing knowledge, and (3) initiation of specific kinds of activities in advance of a large-scale cooperative study. Potential initial sites for these studies are at Lake Wingra, Wisconsin; Lake George, New York; the Duke University Forest, North Carolina; and the Coweeta Hydrological Laboratory, North Carolina.

Desert Biome

A plan for the desert biome subprogram has been completed, and a proposal for management and coordination of the study has been submitted to a granting agency for funding. The Director is David W. Goodall, Utah State University, Logan, Utah 84321.

The objective of the proposed research is to gain an understanding of (1) the patterns and processes affecting productivity of desert ecosystems in the United States and (2) the effects of different forms of land-use perturbation on these patterns and processes. Data to be collected will represent in a computer model the flow of materials between trophic levels, species, and age groups and the way in which the flow is influenced by environmental factors. As a result, the effects of environmental changes can be predicted by simulation.

Initial work is planned in the Great Basin and Sonoran Deserts. Later, work may be done in the Mohave and Chihuahuan Deserts.

Coniferous Forest Biome

A plan for the coniferous forest biome subprogram has been completed, and a proposal for management and coordination of the study is under review. The Director is Stanley P. Gessel, College of Forest Resources, University of Washington, Seattle, Wash. 98105.

The purpose of the proposed research is to develop a better understanding of (1) patterns and processes affecting productivity of coniferous forest ecosystems in the United States and (2) the effects of different forms of land use and vegetation manipulation on these patterns and processes. Data to be collected will represent in a computer model the flow of materials between trophic levels, species, and age groups and the way in which the flow is influenced by environmental factors.

Tundra Biome

This subprogram is in the planning stage. The Director is Frank A. Pitelka, Department of Zoology, University of California, Berkeley, Calif. 94720.

Tropical Forest Biome

This subprogram is being developed. A director has not been appointed.

CONVERGENT AND DIVERGENT EVOLUTION

Status. Coordination and management of the program on convergent and divergent evolution are supported by the U.S. Department of the Air Force. Contributing projects are supported by the National Science Foundation, the U.S. Department of Health, Education, and Welfare, and the National Aeronautics and Space Administration. Many South American institutions support the objectives of this program.

Director. W. Frank Blair, Department of Zoology, University of Texas, Austin, Tex. 78712

Assistant Director. M. J. Fouquette, Department of Biology, Arizona State University, Tempe, Ariz. 85281

Co-Assistant Directors. Fernando Dias de Avila-Pires, Museu Nacional, Rio de Janeiro, Brazil

Francesco di Castri, Universidad de Chile, Santiago, Chile

José M. Cei, Universidad Nacional de Cuyo, Mendoza, Argentina

Alvaro Fernandez-Pérez, Instituto de las Ciencias Naturales, Universidad Central, Bogotá, Colombia

Harold Mooney, Stanford University, Stanford, Calif. 94305

T. E. Moore, The University of Michigan, Ann Arbor, Mich. 48104

Rodolfo Ruibal, University of California, Riverside, Calif. 92507

Otto Solbrig, The University of Michigan, Ann Arbor, Mich. 48104

The main part of the program on convergent and divergent evolution was developed at a working conference in Caracas, Venezuela, November 22-24, 1967. Scientists from various countries of Latin America, the United States, and Australia attended.

This program as it relates to the Western Hemisphere is directed mainly to two major cooperative, international projects. One is the investigation of the divergent evolution within taxa (genera or families) of organisms that occur in both North and South America and in some instances in both the New World and the Old World. The evolutionary history of such groups and, consequently, an assessment of evolutionary time rates and evolutionary processes can be determined satisfactorily only through truly cooperative, coordinated research.

The second of these international projects is concerned with the poorly understood evolutionary phenomenon of convergent evolution, whereby evolutionary lines of organisms that are similar genetically, but quite independent, undergo adaptive radiation to fill similar ecological niches that are sometimes remarkably similar.

Environments for life are similar in North and South America, being distributed in a mirror-image pattern. Comparative studies of ecosystems and of the niches that organisms occupy in them in similar environments of the two continents provide our most promising approach to an understanding of convergent evolution.

Several taxa are found both in the American tropics and in Australia. The history of these distributions is a matter of speculation, and it can be expected that comparative multidisciplinary studies will reveal the amount of convergent evolution versus actual kinship.

The program has a third aspect: the evolutionary dynamics of the native and invading biotas of the land areas of the Hawaiian Islands. This phase of the research provides an opportunity to study evolutionary and ecological phenomena in an isolated locality where the forces at work are well documented. Native plants and animals in the Hawaiian Islands have evolved from about 700 immigrant species that arrived by natural processes of distribution over the course of perhaps 10 to 15 million years. Since the arrival of man, the isolation that permitted this evolutionary development has been severely altered, and many of the naturally occurring plants and animals have disappeared. The Islands are thus a unique laboratory for discovering the mechanisms by which contaminating organisms replace native ones. The information is of criti-

cal importance to worldwide understanding of how plant and animal communities can be protected and maintained in a productive state.

Convergent and Divergent Evolution in Various Taxa

Investigations of the evolution of widely distributed taxa are directed to various groups of organisms, particularly amphibians, fishes, mammals, reptiles, insects, and plants.

Amphibians

The investigation of amphibians has involved an expansion of cooperative inter-American research that has been in existence for several years. Since the most interesting evolutionary questions are those requiring cooperation by workers from various parts of the areas of distribution, it is important to encourage geographic expansion.

Two large adaptive radiations of anurans have their greatest differentiation in the neotropics. We know little about their evolutionary relations and the evolutionary mechanisms involved in their differentiation. These radiations consist of the family Hylidae and the family Leptodactylidae. Another center of adaptive radiation of these groups is Australia. The degree of relationship between South American and Australian forms is unknown.

Attempts will be made to answer these main questions concerning the Hylidae:

- What are the relationships of the Hylidae of the New World?
- What is the relative ecological and taxonomic diversity of the Hylidae in various ecological and geographical provinces? What is the relation to environmental diversity? Has ecological convergence taken place?
- What is the degree of relationship between the Hylidae of the New World and those of Australia?

Attempts will be made to answer these main questions concerning the Leptodactylidae:

- What is the degree of relationship among the neotropical genera and subfamilies?
- What is the degree of relationship between the Leptodactylidae of the New World and those of Australia?

In addition, there are various poorly known taxa of anuran amphibians in South America that will presumably provide much information about the evolutionary history of the anura when their relationships have been subjected to multidisciplinary study. Important among these are the genera *Odontophrynus, Thoropa, Telmatobius, Telmatobufo, Calyptocephalella, Macrogenioglottus,* and *Eusophus,* and the families of Atelopidae and Dendrobatidae.

Persons identified with research on amphibians are as follows:

Argentina

Buenos Aires

Avelino Barrio, Instituto Nacional de Microbiologia (bioacoustics, biochemical systematics)
Celia Limeses de Ikonokoff, Universidad de Buenos Aires (osteology)
Primarosa Reinaldi, Instituto Nacional de Microbiologia (cytotaxonomy)

Mendoza

Jose M. Cei, Instituto de Biologia, Universidad Nacional de Cuyo Mendoza (ecology, biogeography, biochemical systematics)

Australia

Melbourne

M. J. Littlejohn (bioacoustics, hybridization)

Brazil

Rio de Janeiro

Bertha Lutz, Museu Nacional (ecology, life history, biogeography, morphology)
Antenor Leiteo de Carvalho, Museu Nacional (taxonomy of Microhylidae, larval development)
Eugenio Izecksohn, Universidad Rural (bioacoustics)

São José do Rio Prêto

Luis Dino Vizotto, Universidad de São José do Rio Prêto (bioacoustics)

São Paulo

Willy Beçak, Instituto Butantan (cytotaxonomy)
Maria Beçak, Instituto Butantan (cytotaxonomy)

Canal Zone

Barro Colorado

Stanley Rand (ecology, bioacoustics)

Chile

Santiago

Klaus Busse-G., Centro de Investigaciones Zoologías (ecology)
Jose Valencia, Universidad de Santiago (life history, ecology, hybridization studies)

Valdivia

Ramon Formas, Universidad Austral (biogeography)

Valparaiso

Alberto Veloso, Universidad de Chile (biogeography, physiological adaptation)

Colombia

Bogotá

Pedro Ruiz-C., Instituto de Biología, Universidad Central (speciation, hybridization)
Jorge Hernandez-C., Instituto de Biología, Universidad Central (speciation)

Javeriana

Jaime George, Universidad Javeriana (biochemistry)

Medellín

Fabio Heredia, Universidad de Antioquia (ecology and biogeography)

Peru

Lima

Luis Gonzales-Mugaburu, San Marcos University (parasitology, coccidia speciation relative to speciation of amphibian hosts)
Hernando c. de Macedo, Universidad Cayetano (Andean frogs)

Puerto Rico

Mayaguez

Juan Rivero, University of Puerto Rico at Mayaguez (morphology, ecology, distribution)

United States

Arlington, Tex.

William F. Pyburn, University of Texas (ecology)

Austin, Tex.

W. Frank Blair, University of Texas (hybridization)
James P. Bogart, University of Texas (cytotaxonomy)
Terry Mathews, University of Texas (behavioral genetics)
Richard Newcomer, University of Texas (biochemical evolution)

Bloomington, Ind.

Craig E. Nelson, Indiana University (bioacoustics, morphology, ecology)

Boston, Mass.

Richard Estes, Boston University (paleontology)

Fargo, N. Dak.

Otto M. Sokol, North Dakota State University (larval morphology)

Tempe, Ariz.

M. J. Fouquette, Arizona State University (bioacoustics)

Uruguay

Montevideo

Francesco Alberto Saez, Instituto de Biología (cytotaxonomy)
Nadir Brum-Zorilla, Instituto de Biología (cytotaxonomy)

Venezuela

Caracas

Haydee Solano de Chacín (morphology)

Fishes

Research on fishes in the neotropics has lagged behind research on other vertebrate groups. (Only about half of the fishes of the Amazon basin have been described at the lowest taxonomic level.) Comparing the ecological niches occupied by South American freshwater fishes with those occupied by North American freshwater fishes would be interesting and challenging.

Attempts will be made to answer certain questions concerning communities derived from different evolutionary lines, including:

- How similar are the communities in organization and in quality and quantity of ecological niches?
- How similar are the niches?

An integrated project in this phase of research, supported by the National Science Foundation, is "Zoogeographical Relationships of South American Fishes as Indicated by Their Parasites." Research will consist in (1) analyzing specimens of freshwater fish groups in South America for trematodes and (2) seeking evidence for "index parasites" useful in elucidating zoogeographical and phyletic relationships of the fishes and parasites. The investigator will be Ernest J. Hugghins, Entomology-Zoology Department, South Dakota State University, Brookings, S. Dak. 57006. Cooperating with him will be Abelardo Vildoso B., Jefe de Investigacion Hidrobiologica, Servicio de Pesqueria, Francisco de Zela 2656, Lince, Lima, Peru.

Other persons identified with research on fishes are as follows:

Argentina

William Birkhead, Universidad de Córdoba, supported by an Air Force Office of Scientific Research Grant to W. F. Blair for study of fishes of streams of the Sierra Córdoba that occupy ecological niches convergent on those occupied by fishes of similar environments of North America.

Chile

Santiago

Irma Vila Pinto, Division de Pesca, Casilla 9344
Nibaldo Bahamonde, Museo Nacional de Historia, Casilla 787

Valdivia

Hugo Campos-C., Universidad Austral (galaxiid evolution)

Peru

Lima

Hans Wilhelm Koepcke, Museo de Historia Natural, Avenida Arenales 1256

Mammals

Although South America is rich in mammalian diversity, little research on mammalian systematics and evolution has been performed.

Both South American and North American mammalogists will participate in research on mammals. As a preliminary step, Dr. Fernando de Avila-Pires, Museu Nacional, Rio de Janeiro, Brazil, hopes to conduct a series of short courses. Others identified with this research are as follows:

Argentina

Mendoza

Vergilio Roig, Instituto de Biología, Universidad Nacional de Cuyo

Colombia

Bogotá

Jorge Hernandez Camacho, El Instituto de Ciencias Naturales

Venezuela

Caracas

Osvaldo Reig and associates, El Instituto de Zoologia Tropical

Reptiles

The reptiles, like the mammals, are excellent for use in investigating the mechanisms and results of convergent evolution in similar environments. Several ongoing investigations are identified with the objectives of the research on reptiles:

Comparison of the differentiation of lizards on islands and in their source areas

E. E. Williams, Harvard University
Eviatar Nevo, Hebrew University, Jerusalem
George Gorman, University of California at Berkeley

Ecological adaptation and ecological niches of lizards of southwestern North America

Frederick B. Turner, Laboratory of Nuclear Medicine and Radiation Ecology, University of California at Los Angeles

Evolution of the amphicentric turtle genus *Chrysemys*

Walter Auffenberg, Florida State Museum, Gainesville
Marcos A. Frieberg, University of Buenos Aires, Buenos Aires

Population biology and niche adaptation of lizards in sub-Andean environments of Argentina

Richard D. Sage, graduate student, University of Texas at Austin (present address c/o Dr. Jose M. Cei, Universidad Nacional de Cuyo, Mendoza, Argentina)

Ecological niches of geckos in northern Peru

Raymond B. Huey, graduate student, University of Texas at Austin

Reptiles of Peru

Nelly C. de Espinoza, Museo de Historia Natural, Lima

Insects

The enormous diversity of insect taxa found in North and South America provides virtually unlimited opporhunity for investigation of convergent and divergent evolution. The following investigations have been identified:

Systematics, evolution, and acoustical behavior of cicadas and other insects

T. E. Moore, The University of Michigan, Ann Arbor

Comparative study of bee pollination and plant-insect coevolution in the disjunct arid and semiarid regions of the Americas

Charles Michener, University of Kansas, Lawrence

Incipient speciation in *Drosophila*

Theodosius Dobzhansky, Rockefeller University, New York, N.Y.

A coordinated project in Argentina is "Systematic and Ecological Studies of the Sub-Andean Entomofauna." Investigators are Abraham Willink (Hymenoptera), Lionel A. Stange (Neuroptera), and Arturo Terán (Bruchidae), all of the Instituto Miguel Lillo, Tucumán, Argentina.

Plants

The objectives of the research on plants are:

- To elaborate the results of convergent and divergent evolution of selected genera with disjunct distributions in North and South America.
- To unravel the floralistic relationships between the two areas.
- To investigate the factors controlling population variation and the processes promoting convergent and divergent evolution in the two areas.
- To relate these factors to the geologic and recorded history of the areas.

The methods will be those of biosystematics and genecology.

Coordinator. Otto T. Solbrig, The University of Michigan, Ann Arbor

Co-Principal Investigators. Arturo Burkart, Director, Instituto Darwinion, Argentina Academy of Sciences, and Professor of Botany, University of Buenos Aires
Armando Hunziker, Professor of Botany, University of Córdoba
Juan Hunziker, Professor of Botany, University of Buenos Aires
Benno Ch. Schnack, University of La Plata

Associate Investigators. Lionel Guisti and Alberto Soriano, University of Buenos Aires

Collaborating Investigators. Artùro Gomez Pompa, University of Mexico
Beryl Vuielleumier, Harvard University

The following projects are integrated with the research on plants:

Origin of certain cultivated plants of Latin America

Making taxonomic and cytogenetic studies of certain Latin American cultivated plants and their wild relatives, primarily Andean plants, such as: peppers (*Capsicum spp.*), quinoa (*Chenopodium quinoa*), chocho (*Lupinus mutabilis*), naranjilla (*Solanum quitoense*), and pepino (*Solanum muricatum*). •Research supported by National Science Foundation.
Investigator. Charles B. Heiser, Jr., Department of Botany, Indiana University, Bloomington, Ind. 47401

Value of phytosociological data for interpreting succession and soil-vegetation patterns in mixed tropical forests

Gathering phytosociological data in order to further evaluate their use for the interpretation of succession and soil-vegetation patterns in the species-rich tropical forest on Barro Colorado Island, Canal Zone. •Research supported by National Science Foundation.

Investigator. Dennis H. Knight, Department of Botany, University of Wyoming, Laramie, Wyo. 82070.

Convergence in Ecosystems

Research on convergence in ecosystems will be directed to determining the nature of convergence in selected ecosystems and the extent to which environments are homologous.

By making these determinations and by comparing the similarities and differences discovered, it should be possible to gain a better understanding of the way in which homologous environments have elicited similar responses and led to formation of similar ecosystems, even though the organisms initially selected by these pressures may

have been distinct. Better understanding of this process should lead to information on how similar ecosystems are put together. This information, in turn, should provide knowledge about the nature of ecosystems and about the effects of external disturbances, including the disturbance associated with human activities.

Research will be concerned with three groups of ecosystems. The groups and the countries having a particular interest in each are as follows:

- Warm desert scrub (Venezuela, Argentina, Chile, Mexico, United States).
- Sclerophyll scrub forest (Chile, United States).
- Subtropical-tropical savanna (Venezuela, Brazil, Argentina, Chile, Mexico, United States).

The following projects have emerged:

Comparative study of two semiarid, vegetative, subtropical environments in North and South America

Participants will include Jorge Morello, INTA, Colonia Benitez, Argentina; Jorge Adamoli, INTA, Agropecuaria, Buenos Aires, Argentina; and Francesco di Castri, Universidad de Chile, Santiago, Chile.

Convergent evolution in similar American plant communities

Participants will include Ernesto Medina, M. Monasterio, and G. Sarmiento, Central University, Caracas, Venezuela.

Ecosystem convergence in the Mediterranean climates of Chile and California

To be coordinated by Harold Mooney, Stanford University, Stanford, Calif., and Francesco di Castri, University of Chile, Santiago. Other U.S. participants: Martin L. Cody, University of California, Los Angeles; Albert W. Johnson, San Diego State College; and Peter H. Raven, Stanford University. Participants from University of Chile, Santiago: Vicente Astudillo, Ernst R. Hajek, Francisco Saiz, Rene Covarrubias, Ines Rubio, Wladimir Hermosilla, Valeria Vitali di Castri, Jaime Nazar, and Jaime Pefaur. Participants from other Chilean institutions: Gertrude Franz, Pablo Weisser, Federico Schlegel, and Francisco Silva.

An integrated project, supported by the National Aeronautics and Space Administration and by subcontract to Oregon State University, is "Desert Microbiology and Microflora." Research will consist in (1) studying the basic groups of soil microorganisms that exist in soils in deserts and other extreme environments; (2) obtaining information about the physical and chemical environment in these soils; and (3) continuing studies of desert soils from the Antarctic zone and from Chile, Israel, Egypt, Argentina, western United States, Alaska, and Hawaii. Investigators will be Roy E. Cameron, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif. 91103; Walter E. Bollen, Karen M. Byers, and Sumi Nishikawa, Department of Microbiology, Oregon State University, Corvallis, Ore. 97331; and Eugene E. Staffeldt, Department of Biology, New Mexico State University, Las Cruces, N. Mex. 88001.

Convergence in Physiological Adaptation

A two-step approach to study of convergence in physiological adaptation is planned. First, a small group of scientists will consider the ecosystem broadly; they will carry out a survey and identify particular areas for detailed consideration. Second, the physiological ecology of defined species will be studied.

Research is in three parts. Statements on these components follow.

Physiological Ecology of Desert Mammals

The physiology of desert mammals of South America is virtually unknown. Research will include a study of the physiological ecology of South American rodents, marsupials, and endentates, with emphasis on temperature regulation, metabolic rates, water balance, and photoperiod. The purpose is to provide comparative data for South American forms and to determine whether they demonstrate the same physiological adaptations that have been exhibited by North American desert mammals.

Investigators: Jack Hudson, Cornell University, Ithaca, N.Y.; Virgilio Roig, Instituto de Biologia, Mendoza, Argentina; Mark Ryan and Lloyd Tevis, University of California, Riverside.

Physiological Ecology of Desert Amphibians

The purpose of this research is to ascertain the physiological mechanisms that the amphibians of desert areas utilize in their adaptation to a dry terrestrial habitat.

Investigators: Virgilio Roig, Instituto de Biologia, Mendoza, Argentina; Rodolfo Ruibal, and Vaughn Shoemaker, University of California, Riverside, Calif.; Lon McClanahan, California State College, Fullerton, Calif.

Gas Exchange and Temperature Tolerance in Amphibians

This study will be concerned with pulmonary, cutaneous, and branchial respiration in amphibian species from diverse habitats. The investigator is Victor Hutchison, University of Rhode Island, Kingston, R.I.

Hawaiian Terrestrial Biology

Co-Directors. J. Linsley Gressitt, Bernice P. Bishop Museum, Honolulu, Hawaii 96819

Andrew T. Berger, Department of Zoology, University of Hawaii, Honolulu, Hawaii 96822

This phase of the program on convergent and divergent evolution will consist of a comprehensive study of the endemic and invading biotas of the Hawaiian Islands.

Following are descriptions of research projects that have been integrated with the Hawaii study.

Cytotaxonomic and evolutionary studies of Hawaiian Sciaridae (Diptera)

Studying intensively the origin, evolution, and cytology of the Hawaiian Sciaridae; investigating its probable affinities with the Pacific and New World Sciarid fauna. •Research supported by National Science Foundation.

Investigator. Wallace A. Steffan, Department of Entomology, Bernice P. Bishop Museum, Honolulu, Hawaii 96819

Evolution and genetics of Hawaiian Drosophilidae

Studying certain aspects of the evolution and genetics of the family Drosophilidae, which has 650 to 700 species in

the Hawaiian Islands; establishing native species in artificial media for laboratory study, which will include taxonomy, comparative morphology, ecology, behavior, genetics, enzyme analysis, nutrition, and biochemical and microbiological studies of the breeding media. •Research supported by (1) University of Hawaii, (2) University of Texas Genetics Foundation, and (3) National Institutes of Health, U.S. Department of Health, Education, and Welfare.

Investigators. D. Elmo Hardy, Department of Entomology, University of Hawaii, Honolulu, Hawaii 96822

R. Malcolm Brown, Department of Botany, University of Texas, Austin, Tex. 78712

T. Okada, Marshall R. Wheeler, and Hei Yang, Department of Zoology, University of Texas, Austin, Tex. 78712

Kathleen M. Resch and E. Susan Rockwood, Genetics Foundation, University of Texas, Austin, Tex. 78712

Hampton L. Carson and Harrison L. Stalker, Department of Biology, Washington, University, St. Louis, Mo. 63130

Frances E. Clayton, Department of Zoology, University of Arkansas, Fayetteville, Ark. 72701

Theodosius Dobzhansky and Rollin Richmond, Rockefeller University, New York, N.Y. 10021

Ora Mae Barber, Kenneth Y. Kaneshiro, Andrew Kuniyuki, John Murphy, Gerald Takei, and JoAnn M. Tenorio, Department of Entomology, University of Hawaii, Honolulu, Hawaii 96822

Henry D. Gaines, 3140 Waialae Avenue, Honolulu, Hawaii 96816

Henry W. Kircher and Kenneth Goodnight, Department of Agricultural Biochemistry, University of Arizona, Tucson, Ariz. 85721

William B. Heed, Department of Zoology, University of Arizona, Tucson, Ariz. 85721

Carmen Kanapi, Department of Zoology, University of Santa Tomas, Manila, Philippines

Michael P. Kambysellis, Harvard University Biological Laboratories, 16 Divinity Avenue, Cambridge, Mass. 02138

Haruo Kurokawa, Department of Biology, Tokyo Metropolitan University, 2-1-1. Fukasawa, Setagaya-ku, Tokyo, Japan

Puliyampetta S. Nair, Guruvayurrupan College, Calicut, Kerala, India

Forbes W. Robertson, Institute of Animal Genetics, West Mains Road, Edinburgh 9, Scotland

Michael Shook, Department of Microbiology, 2538 The Mall, University of Hawaii, Honolulu, Hawaii 96822

Herman T. Spieth, Department of Zoology, University of California, Davis, Calif. 95616

Haruo Takada, Kushiro Women's College, Kushiro, Hokkaido, Japan

Lynn H. Throckmorton, Department of Zoology, University of Chicago, Chicago, Ill. 60637

Joseph Grossfield, Department of Zoology, Indiana University, Bloomington, Ind. 47401

Insects of Hawaii: Chalcidoidea

Attempting to complete a systematic monograph on the Hawaiian Chalcidoidea, in which hosts, distribution, and other biological information scattered throughout the literature will be drawn together and presented in concise form; studying phylogenetic relations of genera and species; consulting with leading specialists in the Chalcidoidea of the world; examining type specimens in museums. (The Hawaiian Chalcidoidea are represented by nearly 400 species. Many are entomophagous insects not adequately known.) •Research supported by National Science Foundation.

Investigator. Carl M. Yoshimoto, Entomology Department, Bernice P. Bishop Museum, Honolulu, Hawaii 96822

BIOGEOGRAPHY OF THE SEA

Status. Proposals for the program on biogeography of the sea have been submitted to the National Science Foundation in four planned and integrated groups as a result of a working conference held at the Duke University Marine Laboratory, Beaufort, N.C., October 23-26, 1967. A management-coordination proposal has also been completed and has been submitted for funding consideration. Some of this work is ongoing and is described below.

Co-Directors. F. John Vernberg, Duke University Marine Laboratory, Beaufort, N.C. 28516

Donald E. Wohlschlag, Marine Science Institute, University of Texas, Port Aransas, Tex. 78373

Program Adviser. C. Ladd Prosser, Department of Physiology, University of Illinois, Urbana, Ill. 61801

Scientific Coordinator. To be appointed

Coordinating Committee. Frederick Aldrich, Marine Sciences Research Laboratory, Memorial University, St. John's, Newfoundland, Canada

Melbourne R. Carriker, Systematics-Ecology Program, Marine Biological Laboratory, Woods Hole, Mass. 02543

Frederick Kalber, Department of Biology, Florida Atlantic University, Boca Raton, Fla. 33432

Paulo Sawaya, Department of Physiology, University of São Paulo, São Paulo, Brazil

F. John Vernberg, Duke University Marine Laboratory, Beaufort, N.C. 28516

Donald E. Wohlschlag, Marine Science Institute, University of Texas, Port Aransas, Tex. 78373

The objective of the program on biogeography of the sea is to achieve a better understanding of the unique combinations of the environmental and biological parameters that limit the distribution of marine organisms in the sea. Physiological and ecological specialists will be brought together to assess the effects of changes in prominent environmental factors on specified physiological parameters in a relatively few broadly distributed species.

The program will be in three parts: research management, research projects, and research training.

Within individual projects, training will be conducted by investigators engaged in research. Training within the overall study is proposed on the basis of (1) a specialized graduate-student program to cover ecologically and geographically diverse environments, (2) postdoctoral research awards, and (3) predoctoral research traineeships.

The initial research projects are divided into four coordinated groups, as follows:

Dispersal, speciation, aud acclimitization in predatory marine gastropods

With special emphasis on the successful species *Urosalpinx cinerea* (Say), examining histological, physiological, biochemical, and histochemical responses to controlled environmental stress; making cytological, cytogenetic, and ultrastructural comparisons of various organ systems in both adult and developmental stages. (Other phases of research are concerned with comparative morphometry of hard tissues and comparative immunoelectrophoresis.)

Investigators. Matthew F. Sak and Kenneth R. H. Read, New England Aquarium Corporation, Central Wharf, Boston, Mass. 02110

Thomas D. Myers, Department of Biological Sciences, University of Delaware, Newark, Del. 19711

George E. Krantz, Bureau of Commercial Fisheries Biological Laboratory, Oxford, Md. 21654 (Research at this laboratory is ongoing and is supported by the Bureau of Commercial Fisheries, U.S. Department of the Interior.)

Langley Wood, Virginia Institute of Marine Science, Gloucester Point, Va. 23062

Edward D. DeLamater, Department of Biological Science, Florida Atlantic University, Boca Raton, Fla. 33432

Experimental biogeography of marine crustacea

Conducting a broad study of the distribution and ecological roles of a restricted number of species of marine crustaceans that occupy diverse habitats and represent distinctive links in the food web of the sea; concentrating on (1) toleration studies (resistance adaptations), (2) reproduction, larval development, and growth, (3) behavioral responses, (4) osmoregulation and ionic regulation, (5) metabolic adaptatiôn, and (6) biochemical characteristics.

Investigators. A. N. Sastry, Department of Oceanography, University of Rhode Island, Kingston, R.I. 02881 (reproductive physiology and ecology)

Michael Salmon, Department of Zoology, University of Illinois, Urbana, Ill. 61801 (influence of temperature on behavior and distribution, emphasis on fiddler crabs)

Paul A. Haefner, Jr., Department of Zoology, University of Maine, Orono, Maine 04473 (influence of temperature on osmoregulation and ionic regulation, emphasis on sand shrimp)

Don C. Miller, Biology Laboratory, Union College, Schenectady, N.Y. 12308 (influence of temperature, salinity, and photoperiod on metabolic compensatory adaptations)

Frederick A. Kalber, Jr., Department of Biology, Florida Atlantic University, Boca Raton, Fla. 33432 (effects of temperature and pressure on osmoregulation and ionic regulation in the larvae)

C. G. Bookhout and J. D. Costlow, Jr., Duke University Marine Laboratory, Beaufort, N.C. 28516 (effects of controlled environmental factors on the development and distribution of estuarine and oceanic crustacea)

F. John Vernberg, Duke University Marine Laboratory, Beaufort, N.C. 28516 (Copepod, *Euterpina acutifrons;* biochemical differentiation in latitudinally separated populations)

W. B. Vernberg, Duke University Marine Laboratory, Beaufort, N.C. 28516 (Copepod, *Euterpina acutifrons)*

Geographical distribution of marine fungi: physiological experiments on the interaction of temperature and salinity

Coordinating investigation of factors that determine the geographical distribution of higher marine fungi; establishing pure cultures of Ascomycetes and Deuteromycetes from habitats that include cold water, warm water, and cosmopolitan species. (Emphasis at University of North Carolina will be on the reproductive phase of the life cycles. Emphasis at Barnard College, Columbia University, will be on the survival and growth of the vegetative phases. Data on the establishment of relations between artificial culture and the geographical distribution of these particular plants will be used to make generalizations concerning survival, reproduction, and distribution of marine fungi in general.)

Investigators. Jan Justus Kohlmeyer, University of North Carolina Institute of Marine Sciences, Morehead City, N.C. 28557

Donald D. Ritchie, Department of Biological Sciences, Barnard College, Columbia University, New York, N.Y. 10027

Marine and estuarine microbial ecology

Conducting an interdisciplinary study of marine and estuarine microbial ecology in four locations: an area relatively untouched by man (Sapelo Island, Georgia), a moderately polluted area (Chesapeake Bay), a heavily polluted area (Long Island Sound), and an intermediate area on the west coast (Puget Sound); coordinating procedures for sampling, isolating, and culturing bacteria, and for measuring physical and chemical parameters; providing a workable taxonomy for marine bacteria; computerizing the data to provide a diagnostic center for marine and estuarine bacteria.

Investigators. Rita R. Colwell, Department of Biology, Georgetown University, Washington, D.C. 20007 (Eastern Bay and Marumsco Bar, in Chesapeake Bay)

G. B. Chapman, Department of Biology, Georgetown University, Washington, D.C. 20007

J. D. Buck and B. J. Cosenza, Biological Sciences Group, Marine Research Laboratory, University of Connecticut, Storrs, Conn. 06268 (Long Island Sound)

J. Liston, College of Fisheries, University of Washington, Seattle, Wash. 98105 (Port Orchard, Puget Sound)

William J. Wiebe, Department of Microbiology, University of Georgia, Athens, Ga. 30601 (Sapelo Island, Duplin River)

An integrated project in the program on biogeography of the sea is "Zoophysiology of Oceanic Benthic Animals off the North Carolina Coast." Research will consist in (1) characterizing the physiological parameters operative on oceanic benthic animals in a submerged reef off the Florida current and in a cold-water area north of Cape Hatteras and Diamond Shoals; (2) investigating resistance and adaptive responses of various stages in the life cycle of the dominant species in the two areas named; (3) measuring various overt function responses and metabolic-temperature curves on animals acclimated to different thermal levels; and (4) measuring osmoregulatory ability at different temperatures. The investigators will be F. John Vernberg and Winona B. Vernberg, Duke University Marine Laboratory, Beaufort, N.C. 28516.

PHYSIOLOGY OF COLONIZING SPECIES

Status. A proposal for this program is under development.

Director. Calvin McMillan, Department of Botany, University of Texas, Austin, Tex. 78712

Associate Directors for Plant Research. To be selected

Associate Directors for Animal Research. To be selected

The program on the physiology of colonizing species is in two main parts: plant research and animal research. Statements on research components in each of these divisions follow.

Plant Research

Colonizing Grass Populations

This phase of the research consists in comparing native and invading grasses at different latitudes to determine the basic physiological mechanisms that promote aggressive patterns.

Investigators. Calvin McMillan, Department of Botany, University of Texas, Austin, Tex. 78712 (native grass populations in the United States and Mexico)

Guillermo Sarmiento, Universidad de Venezuela, Caracas (llanos of Venezuela)

M. Sarmiento, Universidad de Venezuela, Caracas (native grass populations of the Calabozo region)

Henrique P. Veloso, Instituto Oswaldo Cruz, Rio de Janeiro, Brazil (vegetation in Brazil)

Thomas R. Soderstrom, U.S. National Museum, Smithsonian Institution, Washington, D.C. 20560 (grasses of Brazil)

Scientists in Argentina are being encouraged to participate in this part of the program.

Germination and Seedling Responses

The objective of this phase of the research is to establish what environmental responses in respect to seed germination and seedling development are important to the success of weedy species in colonizing and taking possession of areas disturbed by man. The intent is to investigate certain species that are important colonizers in three geographically and climatically different regions.

Investigators. Peter Ray, Stanford University, Stanford, Calif. 94305 (colonization of roadsides and fields of the southwestern United States by *Xanthium strumarium* and *Amsinckia* spp.)

Ernesto Medina, Universidad de Venezuela, Caracas (colonization of plowed or overgrazed savanna in the llanos of Venezuela by *Hyptis suaveolens*)

Arturo Gomez-Pompa, Universidad Nacional de Mexico, Mexico City (colonization of forest land that has been cleared by the cut-and-burn methods practiced in the gulf coast region of Mexico, a region of heavy tropical forest having marked wet and nearly dry seasons)

Study of Aggressive Woody Colonizers of Arid Regions

This comparative study of *Prosopis* (*P. juliflora* in the Northern Hemisphere and *P. ruscifolia* in the Southern Hemisphere) and *Acacia* should provide a fuller understanding of some of the physiological mechanisms that allow a woody colonizer to expand its range in arid regions.

Investigators. Jorge Morello, Israel Feldman, and Jorge Adamoli, Instituto Nacional de Tecnologia Agropecuaria, Buenos Aires (chacoan vegetation)

Arturo Ragonese, Instituto Nacional de Tecnologia Agropecuaria, Buenos Aires (plant geography of the Chaco, flora of the Chaco)

J. Talmer Peacock, Texas A & I University, Kingsville, Tex. 78363 (differentiation in *Prosopis* and *Acacia*)

Calvin McMillan, University of Texas, Austin, Tex. 78712 (differentiation in *Prosopis* and *Acacia*)

Comparison of Noncolonizing and Colonizing Species in the Genus *Eucalyptus*

In general it is known that most species of *Eucalyptus* growing in the Western Hemisphere belong to the subgenus *Macranthereae* and that species of the subgenus *Renanthereae*, which contains some of the most economically important trees in Australia, have for the most part failed when introduced. The proposed research is designed to determine the difference between the colonizers of one subgenus and the noncolonizers of the other subgenus. The study will include an international field trial and laboratory comparisons of physiological differences.

Investigators. L. D. Pryor, Australian National University, Canberra

Alvaro Fernandez-Perez, Universidad de Colombia, Bogotá

Calvin McMillan, University of Texas, Austin, Tex. 78712

Physiology of the Colonizer with Wide Adaptation

Among the species with wide distribution are weedy plants that possess a wide range of environmental tolerances. Species that may have become widespread without specialized race-formation will be investigated under controlled conditions.

Investigators. H. G. Baker, University of California, Berkeley (*Lythrum*, *Veronica*, and *Cortaderia*)

Otto Solbrig, The University of Michigan, Ann Arbor (distributional mechanisms of *Taraxacum officinale*)

Peter Ray, Stanford University, Stanford, Calif. 94305 (distributional mechanisms of *Taraxacum officinale*)

Juan Hunziker, Universidad de Buenos Aires (distributional mechanisms of *Taraxacum officinale*)

Calvin McMillan, University of Texas, Austin (distributional mechanisms of *Nicotiana glauca* and *Melia azedarch*)

Robert Lloyd, University of Hawaii, Honolulu (Pteridium)

Edward Klekowski, University of Massachusetts, Amherst, Mass. 01002 (Pteridium)

Physiology of Colonizing Trees of Tropical Montane Forests

This research consists in comparing native and invading trees of tropical montane forests to determine basic physiological processes that promote successful invasion of montane forests in the Tropics.

Investigators. Luis A. Fournier, Universidad de Costa Rica, San José (woody plants of Costa Rica)
Calvin McMillan, University of Texas, Austin, Tex. 78712 (*Liquidambar* in Mexico and Central America)
Ernesto Medina, Universidad de Venezuela, Caracas (woody plants of Venezuela)
William Hathaway, North Carolina State University, Raleigh, N.C. 27607

Introduction, Spread, and Current Distribution of Colonizing Species

In this phase of the program, information will be collected about the time and place of introduction of various colonizers, rate of spread, and current distribution.

Investigator. Jack McCormick, Academy of Natural Sciences of Philadelphia, Philadelphia, Pa. 19333

Animal Research

Arthropod Study

The research proposes to investigate the role of arthropod experimental ecology and evolutionary population ecology in understanding the problems of the colonizing species.

Investigators. J. V. Scorza, E. H. Rapaport, and J. E. Rabinovich; Instituto de Zoologia Tropical, Universidad de Venezuela, Caracas

Colonizing Vertebrate Populations

The proposed research deals with biochemical and morphological variation in natural populations of colonizing species of vertebrates in North and South America, particularly the house sparrow (*Passer domesticus*) and the house mouse (*Mus musculus*), introduced from Europe and now widespread throughout the New World.

The proposed research will extend the scope of research presently in progress in Austin and Santiago and will provide opportunities to study natural populations from a great variety of environmental regions in two continents. Among the characteristics of colonizing species are their unusually wide distribution and their tolerance of extremes of environmental factors. To understand the aspects of the genetic systems that permit these distributional patterns, it is essential to investigate populations throughout the range of the species. Therefore, this opportunity for a cooperative attack on common problems of colonization is welcome by both groups of biologists.

Investigators. Robert K. Selander and Suh Y. Yang, Department of Zoology, University of Texas, Austin, Tex. 78712 (morphological and biochemical variations in the house mouse and the house sparrow in North and South America)
Olga Pizarro de Hoecker and Gustavo Hoecker, Instituto de Biologia "Juan Noe," Universidad de Chile, Santiago (histocompatibility antigens of the house mouse)

AEROBIOLOGY

Status. A proposal requesting support was submitted to the National Science Foundation in August 1968.

Director. William S. Benninghoff, Department of Botany, The University of Michigan, Ann Arbor, Mich. 48104

Coordinator. To be selected after funds become available

Advisory Group. Richard D. Schein, College of Science, Pennsylvania State University, University Park, Pa. 16802 (Chairman)
William S. Benninghoff (ex officio)
Lester Machta and Donald Pack, Environmental Science Services Administration, U.S. Department of Commerce, Silver Spring, Md. 20910
Donald S. Meredith, Department of Biology, University of Hawaii, Honolulu, Hawaii 96822
John T. Middleton, National Air Pollution Control Administration, Arlington, Va. 22203
W. D. McClellan, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md. 20705
William Snyder, Department of Pathology, University of California, Berkeley, Calif. 94720
Lucas Calpouzos, Department of Plant Pathology, University of Minnesota, St. Paul, Minn. 55101
William Solomon, Department of Internal Medicine, The University of Michigan, Ann Arbor, Mich. 48104
H. F. Hasenclever, National Institute of Allergy and Infectious Diseases, National Institutes of Health, U.S. Public Health Service, Bethesda, Md. 20014
J. Linsley Gressitt, Bernice P. Bishop Museum, Honolulu, Hawaii 96819
Howard E. Heggested, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md. 20705

The IBP aerobiology program has six segments: Phytopathology, Allergenic Particles in the Atmosphere, Phytogeography and Genecology of Pollen and Spores in the Atmosphere, Human and Animal Pathogens in the Atmosphere, Insects and Other Small Animals in the Atmosphere, and Effects of Gaseous and Particulate Air Pollutants on Plants and Animals.

Phytopathology

Supervisor. W. D. McClellan, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md. 20705

Investigators. Richard D. Schein, College of Science, Pennsylvania State University, University Park, Pa. 16802 (spore loads in the atmosphere)
William Snyder, Department of Pathology, University of California, Berkeley, Calif. 94720 (origins and sources of plant pathogens of major world crops)
Lucas Calpouzos, Department of Plant Pathology, University of Minnesota, St. Paul, Minn. 55101 (assessment of worldwide plant-disease losses)

Objectives:

- To formulate and promote integrated research in three broad areas (see below).

• To improve communications with project scientists in similar research in other countries with the aim of developing a dependable system of international exchange of crop-disease information.

• To coordinate phytopathological research in this subprogram with that in other subprograms.

Following are statements concerning the research areas:

Spore loads in the atmosphere. Research will center on (1) determining source, dissemination mechanisms, and viability in transit of propagules and (2) testing and modifying existing theory concerning components of the dissemination process. Much of this research will be keyed to major crop pathogens of international importance. Coordination with research workers in other countries will be maintained.

Origins and sources of plant pathogens of major world crops. Objectives are to investigate on a worldwide basis (1) places of origin of pathogens, hosts, and diseases; (2) origin and distribution of inoculum and genes for pathogenicity; (3) origin of variation in pathogenicity, in disease expression, and in host reaction; and (4) the place of vectors in disease.

Assessment of worldwide plant-disease losses. Objectives are (1) to measure plant-disease losses in a number of countries; (2) to expand research on remote sensing as a tool for early detection and ready assessment of plant-disease losses; (3) to develop methods for compiling and retrieving data on plant-disease occurrences and losses; (4) to promote research designed to study the relationship between plant-disease losses and time and amount of infection, multiple infections, effects of other pests, and the environment; and (5) to develop improved methods for forecasting plant-disease epidemics.

Allergenic Particles in the Atmosphere

Supervisor. William Solomon, Department of Internal Medicine, The University of Michigan, Ann Arbor, Mich. 48104

Objectives:

• To evaluate the status of research on airborne allergens in the United States, and to recommend further research.

• To formulate and implement a program that will bring into more effective association ongoing aeroallergen research projects, supplemented by new projects needed to fill serious gaps in the advancing research front.

Phytogeography and Genecology of Pollen and Spores in the Atmosphere

Supervisor. William S. Benninghoff, Department of Botany, The University of Michigan, Ann Arbor, Mich. 48104

Objectives:

• To provide a system of information exchange compatible in terms and procedures with systems in other parts of the program.

• To permit storage, retrieval, and collation of data on sampling and tracking of pollen and spores in the atmosphere.

• To advise and assist research workers in formulating and initiating research projects on atmospheric transport of genetic material and related problems.

An integrated project in this subprogram, supported by Consumer Protection and Environmental Health Services. U.S. Department of Health, Education, and Welfare, is "Air Spora in Hawaii." Research will consist in (1) determining the types and frequencies of spores in the air in relation to parameters of the weather in Hawaii, (2) investigating spores of species pathogenic to plants or animals, (3) correlating phytopathogenic spore frequencies with plant-disease outbreaks, and (4) establishing permanent records of impacted fugal spores, particles, crystals, and pollen. The investigators are Ivan W. Buddenhagen and Donald S. Meredith, College of Tropical Agriculture, University of Hawaii, Honolulu, Hawaii 96822.

Human and Animal Pathogens in the Atmosphere

Supervisor. H. F Hasenclever, National Institute of Allergy and Infectious Diseases, National Institutes of Health, U.S. Public Health Service, Bethesda, Md. 20014

Objectives:

• To compile a register of U.S. sampling for human and animal pathogens in the atmosphere.

• To evaluate U.S. problems concerning airborne human and animal pathogens and research activity to meet these problems.

• To develop an integrated program of research, and provide assistance in planning, staffing, and procuring support for new projects on needed research.

• To provide communication between U.S. projects and the Special Committee for the IBP and between U.S. projects and comparable projects in other countries.

• To provide guidance and staffing assistance for training programs in colleges, universities, hospitals, and government laboratories.

Insects and Other Small Animals in the Atmosphere

Supervisor. J. Linsley Gressitt, Bernice P. Bishop Museum, Honolulu, Hawaii 96819

Objectives:

• To formulate a program for clarifying the aerial plankton component consisting of insects and other small animals over selected areas, for specified altitudes and in different seasons.

• To establish communication and cooperation between domestic sampling stations and with stations in other countries, and to coordinate schedules of those stations with sampling from aircraft and ships at sea, utilizing "ships of opportunity" whenever possible.

• To investigate possible benefits from coordination of results from studies of short-scale dispersion of small animals, such as ambrosia beetles, in the interest of clarifying their population and migration characteristics.

Effects of Gaseous and Particulate Air Pollutants on Plants and Animals

Supervisor. Howard E. Heggested, Agriculture Research Service, U.S. Department of Agriculture, Beltsville, Md. 20705

Objectives:

- To evaluate and understand the effects on plants and animals of individual and various combinations of major gaseous pollutants, such as ozone and sulfur dioxide.
- To obtain specific information on sources, dispersal, and dilution with time and distance, and on economic losses attributable to these pollutants.

PHENOLOGY IN RELATION TO HUMAN WELFARE

Status. This program is in the planning stage. An advisory group has participated in the planning, and it is anticipated that an advisory group will be listed in the proposal for management of the program when it is completed.

Director. Byron O. Blair, Department of Agronomy, Purdue University, Lafayette, Ind. 47907

The phenology program will be in three parts: mapping, basic mechanisms, and phenology within communities. Coordination will be maintained with biome directors in the program on analysis of ecosystems.

Mapping

Coordinator. Byron O. Blair, Department of Agronomy, Purdue University, Lafayette, Ind. 47907

Studies identified with mapping phenological events, and the leader of each, are named below.

Plant responses to their environment in the Western United States
Joseph Caprio, Montana State University, Bozeman, Mont. 59715

Plant responses to their environment in the Central United States
William Colville, University of Nebraska, Lincoln, Nebr. 68503

Plant responses to environment in the Northeastern United States
Richard J. Hopp, University of Vermont, Burlington, Vt. 05401

Plant responses to environment in the Southern United States
Leader to be designated

Basic Mechanisms

Coordinator. To be designated

Studies identified with basic mechanisms, and the leader of each, are named below.

Sun compass mechanisms of certain amphibians
Denzel E. Ferguson, Zoology Department, Mississippi State University, State College, Miss. 39762

Energy relationships of homeotherms in the winter environment
Aaron O. Moen, Cornell University, Ithaca, N.Y. 14850

Ecology of pheasant populations in Illinois
Ronald F. Labisky, Illinois Natural History Survey, Natural Resources Building, Urbana, Ill. 61801

Periodicity of height growth in white spruce reproduction
A. K. Kellem, Forestry Branch, Calgary, Alberta, Canada

Wildlife habitat research project
Peter F. Stickney, Intermountain Forest and Range Experiment Station, Provo, Utah 84601

Phenology of plant and animal species associated with urban areas
Robert E. Jones, University of Delaware, Newark, Del. 19711

Microclimate and the response of index crop species
Guy W. McKee, Pennsylvania State University, University Park, Pa. 16802

Phenology of old-field plants and selected forest species
Waterloo Mills Research Station, Devon, Pa. 19333

Phenology of weed germination
Jack McCormick, Academy of Natural Sciences of Philadelphia, Devon, Pa. 19333

Effect of climatic integrants on insect populations
Roger T. Huber, Purdue University, Lafayette, Ind. 47907

Effects of radiation on forest communities
Forest Stearns, Institute of Forest Genetics, Rhinelander, Wis. 54501

Genetics of northern forest trees
Hans Neinstadt, Institute of Forest Genetics, Rhinelander, Wis. 54501

The annual cycle of white-tailed deer
W. N. Holsworth, Griffith Island Research Station, Department of Zoology, University of Western Ontario, London, Ontario, Canada

Phenological studies of selected species in western Oklahoma
James F. Lovell, Southwestern State College, Weatherford, Okla. 73096

Effect of nitrogen and phosphorous fertilizer on plant response
Harold Goetz, North Dakota State University, Fargo, N. Dak. 58102

Life forms of North Dakota vascular plants
Vera Facey, University of North Dakota, Grand Forks, N. Dak. 58202

Seasonal developments of foliage and wood formation
Institute of Forest Genetics, North Central Forest Experiment Station, Rhinelander, Wis. 54501

Phenology within Communities

Coordinator. Daniel Janzen, Department of Entomology, University of Kansas, Lawrence, Kans. 66044

Studies identified with this part of the program, and the leader of each, are named below.

Phenology of grassland species in central Texas
Brother Daniel Lynch, C.S.C., St. Edward's University, Austin, Tex. 78704

Organization of the arthropod communities associated with certain plants

Richard B. Root, Cornell University, Ithaca, N.Y. 14850

Impact of dry season on insect communities in dry and wet tropical lowlands (Costa Rica)

D. H. Janzen, University of Kansas, Lawrence, Kans. 66044

Butterflies of Pondermill Nature Reserve

Harry K. Clench, Carnegie Museum, Pittsburgh, Pa. 15213

Phenological patterns of major cold desert species

Paul T. Tueller, University of Nevada, Reno, Nev. 89507

Comparative productivities of small bodies of water in desert and mountain areas in southern New Mexico

Walter G. Whitford, New Mexico State University, Las Cruces, N. Mex. 88001

CONSERVATION OF ENVIRONMENTS

Status. This program is in progress. Government agencies and foundations interested in conservation are cooperating with the IBP.

Director. John L. Buckley, Office of Science and Technology, Executive Office of the President, Washington, D.C. 20506

Advisory Group. Robert E. Buckman, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250

George Sprugel, Jr., Illinois Natural History Survey, Natural Resources Building, Urbana, Ill. 61801

F. Raymond Fosberg, Smithsonian Institution, Washington, D.C. 20560

Lee M. Talbot, Office of Ecology, Smithsonian Institution, Washington, D.C. 20560

Rezneat M. Darnell, Department of Oceanography, Texas A & M University, College Station, Tex. 77843

G. E. Likens, Department of Biological Sciences, Dartmouth College, Hanover, N. H. 03755

John Randall, Bernice P. Bishop Museum, Honolulu, Hawaii 96819

John Milton, The Conservation Foundation, 1250 Connecticut Avenue, N.W., Washington, D.C. 20036

The program on conservation of environments will include the activities listed below. Where responsibility for carrying out an activity has been assigned, the responsible organization or individual is named.

A. Providing registries of protected natural areas, and of areas requiring protection, on:
   1. Federal lands (responsibility assigned to Federal Committee on Research Natural Areas, Washington, D.C. 20240).
   2. Nonfederal public lands and privately owned lands (responsibility to be assigned on basis of Conservation Foundation report; see E, below).
   3. Privately owned lands (responsibility assigned to program director).

B. Providing for descriptions of these areas (responsibility assigned to agencies responsible for area management and to the program director, with assistance of the scientific community being solicited).

C. Providing guidelines that will be useful in managing and protecting the areas.

D. Providing registries of experimental areas necessary for scientific purposes (e.g., experimental forests, watersheds, and ranges) on:
   1. Federal lands.
   2. State lands.
   3. Privately owned lands (e.g., land owned by a university).

E. Cooperating with other countries of this hemisphere in preparing a list of needed scientific reserves and in stimulating the establishment of such reserves (responsibility assigned to John Milton, The Conservation Foundation, 1250 Connecticut Avenue, N.W., Washington, D.C. 20036).

F. Cataloging freshwater areas that have scientific value (responsibility assigned to Rezneat M. Darnell and G. E. Likens).

G. Cataloging existing reserved marine areas and helping to devise procedures for selecting and protecting marine areas (responsibility assigned to John E. Randall).

BIOLOGICAL PRODUCTION IN UPWELLING ECOSYSTEMS

Status. A proposal on this program has been submitted to a granting agency for funding.

Program Director. Richard C. Dugdale, University of Washington, Seattle, Wash. 98105

Director, Aquiculture Project. John Ryther, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543

Director, Simulation Model Project. Gerald Paulik, University of Washington, Seattle, Wash. 98105

Coordinator of Physical Oceanography. Robert Smith, Oregon State University, Corvallis, Oreg. 97331

The program on upwelling is in three parts:

- Oceanographic cruises—to Peru in 1969 and to the Mediterranean in 1970.
- Projects—one on construction of a simulation model and one on application to aquiculture.
- Conferences and symposia.

The parts are closely related, and some effort will be directed to each in the first year.

Objectives are (1) to obtain sufficient quantitative understanding of the structure and dynamics of upwelling ecosystems to allow prediction of the consequences of perturbations of these and other marine ecosystems when these changes result primarily in enhanced circulation of nutrients into lighted regions of the sea, and (2) to apply the theoretical concepts obtained to pilot aquiculture projects.

The program will provide a focus for investigators whose interests and activities already are closely related to the stated objectives. It is designed to be truly international and yet sufficiently limited in scope and geography to enable investigators to obtain important basic information in a relatively short time and with a modest expenditure of funds.

Research will be concerned with the following problems:

Physical Oceanography. Persistent cold spots on the sea surface along the coast of Peru indicate regions of constant upwelling. It appears, however, that insufficient data are available to allow a choice between two hypotheses. One hypothesis is that the local upwelling is continuous, as if from an underwater fountain. The other is that the upwelling is intermittent with a bolus of cold water forced to the surface and drifting downstream and that it is followed by another water mass.

Nutrient Circulation. Regardless of the mechanism by which the water underlying the pycnocline is mixed or advected into the surface regions, it is clear that the source water in upwelling on the coast of Peru has been modified to some extent by local regeneration. To some degree the region is a nutrient trap. Quantitatively, it appears from an inspection of recent data that regeneration of phosphate occurs at the fastest rate, followed by nitrate and finally by silicate. The sites of regeneration for these primary nutrients are not known and may differ in each case.

Phytoplankton Ecology. The causes of domination of a phytoplankton population by a group of species are largely unknown. Conditions of high productivity favor a smaller number of species, which, in general, are relatively large. At low productivity levels, diversity increases and cell size tends to be smaller. Knowledge of the adaptation that may have evolved in different groups of algae to compete for available nutrients is clearly desirable.

Food Chains. The failure of biological oceanographers to develop ecological theory sufficiently well-grounded to aid fisheries scientists in making regulatory decisions is exemplified in the Peruvian anchoveta fishery. There, as elsewhere, biological oceanography has confirmed the presence of high rates of primary productivity, but the information is of no practical use—a result of lack of information regarding utilization of the phytoplankton by herbivores and by higher elements of the food chain.

Training. Formal training courses are not proposed at this time, but this aspect of the program is inherent in the cruises. Informal instruction in techniques will be given.

Data Analysis. The University of Washington shipboard computer, an IBM 1130, and data analysis equipment for physical, chemical, and biological oceanographic observations will be available on the cruises. With this equipment, the reduced data are available in tabular and graphical form about 6 hours after occupation of a station.

The advantages of providing reduced data to an investigator during oceanographic cruises are obvious. Making the reduced data from hydrographic stations available to the researcher at sea greatly increases his control of the research.

A data-processing system has been implemented to capture, reduce, and store data from routine physical and chemical oceanographic observations. The system includes (1) use of a small shipboard computer for computation and data retrieval, (2) reduced output to include computed values from raw data, (1) X-Y plots of any two variables recorded (e.g., depth versus PO_4^{-} or PO_4^{-} versus SiO_4^{-}) and made available in less than 8 hours, and (4) magnetic disk files for the basic storage medium (as opposed to cards). Physical hydrographic data are recorded on University of Washington standard field logs, from which input data cards are keypunched. Chemical data come from log sheets designed especially for the system and are also keypunched.

The system was designed around the IBM 1130 shipboard computer on the R/V *Thompson*. Programs have been written to establish a data file (on disk), update the file as data are made available, compute chemical values from the keypunched instrument readings, and display the data in lists or plots for use by the scientific party.

The punched output from the files consists of a series of X-Y plots and listings as follows: (1) a report of reduced environment data that includes atmospheric and sea state, Nansen bottle temperature, and the thermometric depths (Z) computed from the temperatures, wire-out length (L), and L-Z values; (2) a list of chemistry data, intended to be used in validating the keypunched raw data and the formulas used to compute the various chemical values placed in the data file; (3) a station report intended to be the main output from the system in circumstances that make it desirable to consolidate the reduced physical and chemical hydrographic data into a single report; and (4) X-Y plots of any two parameters on file. A general-purpose plotting program in the system allows a variety of plotter outputs from the reduced data file on disk.

A safety factor is a card file containing all the reduced data. Programs have been written to reestablish the files on disk if machine failure should prevent access to the files. One program in the system facilitates immediate correction of the data where necessary; it retrieves individual values from the file, allows replacement of the value from the computer console, and subsequently stores the new value in the file.

A major research effort will be made in 1969 in the upwelling region of Peru, beginning with a multiple-ship and aircraft study scheduled for March and April. The R/V *Thompson* from the University of Washington, the R/V *Gosnold* from WHOI, the WHOI DC-6 aircraft, and possibly the R/V *Unanue* from Peru will participate.

Following is a preliminary list of participants in the Peruvian study.

Physical Oceanography

R. Smith, Oregon State University, Corvallis, Oreg. 97331 (current measurements)
L. Larson, University of Washington, Seattle, Wash. 98105 (internal waves)
G. Ewing, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543 (airborne sensors)

Nutrient Circulation

R. Broenkow, University of Washington, Seattle, Wash. 98105 (mathematical models)
M. Pamatmat, University of Washington (regeneration of nutrients at sediment surface)
J. Goering, University of Alaska, College, Alaska 99735 (denitrification)
L. Hobson, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543 (fate of particulate carbon)
D. Menzel, Woods Hole Oceanographic Institution (oxygen consumption rates in regeneration)
S. Watson, Woods Hole Oceanographic Institution (nitrification)
R. Vaccaro, Woods Hole Oceanographic Institution (uptake of dissolved oxygen compounds)
B. Roufogalis, Greek Hydrographic Service, Athens, Greece (nutrient analysis)

Phytoplankton

J. Lewin, University of Washington, Seattle, Wash. 98105 (*Chaetocerus*, silica)
B. Gallis, University of Washington (nutrient uptake control mechanisms)
J. Dugdale-MacIsaac, University of Washington (nutrient limitation)
P. Harrison, University of Washington (thiamine)
T. Packard, University of Washington (nitrate reductase)
R. Eppley, Institute of Marine Research, University of California, San Diego, Calif. 92110 (nitrate reductase, other algal enzymes)
R. Margalef, University of Barcelona, Spain (population structure)
B. Battaglia, University of Padova, Italy (sinking rates in natural populations)
R. Barber, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543 (lag phenomenon, chelation)
J. Ryther, Woods Hole Oceanographic Institution (primary productivity)
J. McCarthy, Institute of Marine Research, University of California, San Diego, Calif. 92110 (nutrient uptake)
M. Hulburt, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543 (phytoplankton distribution)
T. Rennie, University of Colorado, Boulder, Colo. 80302 (quasi-chemostat)
C. Davis, University of Washington, Seattle, Wash. 98105 (quasi-chemostat)

Food Chains

R. Dugdale, University of Washington, Seattle, Wash. 98105 (^{15}N productivity measurements)
L. Conway, University of Washington (^{15}N productivity measurements)
T. Whitledge, University of Washington (flux of creatine as measure of fish population growth rates)
J. M. Peres, Station Marine d'Endoume, Marseille, France (secondary production)
G. Grice, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543 (zooplankton populations)
P. Taylor, University of Washington, Seattle, Wash. 98105 (benthic populations)
R. Jordan, Instituto del Mar del Peru, Peru (anchoveta feeding)
G. Rose, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543 (benthos)

Technical Staff

R. Hansen, P. Dinken, L. Olund, N. Borovokof, R. Olund

The following lists show facilities, equipment, and personnel committed to the program on upwelling by U.S. organizations.

Department of Oceanography, University of Washington

Major facilities: R/V *Thompson* for cruises in Peruvian water in 1969, and tentatively, for Mediterranean cruise in 1970; administrative offices and support facilities; Center for Quantitative Studies in Forestry and Fisheries.

Equipment: Technicon Autoanalyzer system for chemical analyses; shipboard ^{15}N analysis system, including mass spectrometer; shipboard computing and data-analysis system; duplicate shore-based computing and data-analysis system.

Personnel: Senior investigators, 7; graduate students, 6; technicians, 7.

Woods Hole Oceanographic Institution

Major facilities: R/V *Gosnold* for cruise to Peru in 1969; DC-6 aircraft.

Equipment: Airborne sensor gear.

Personnel: Senior investigators, 10; technicians, 3.

Department of Oceanography, Oregon State University

Equipment: Current meters.

Personnel: One senior investigator; two graduate students.

Marine Resources, University of California, San Diego

Major facilities: Two visitor spaces on R/V *Washington* for cruise to Peru late in 1969.

Personnel: One senior investigator; one graduate student.

Smithsonian Institution

Major facilities: Mediterranean Sorting Center, Tunisia.

Statements on participation by foreign organizations and scientists in the program on upwelling follow.

Instituto del Mar del Peru (IMARP)

Dr. Romulo Jordan, who attended the Peru Upwelling Conference, stated that staff members of IMARP wish to participate in the program. Use of the R/V *Unanue* appears feasible. One or two Peruvian scientists will be accommodated on the *Thompson* cruises.

Fisheries Resources and Exploitation Division, Food and Agriculture Organization

A group of fisheries specialists are in residence at IMARP to assist in carrying out a second United Nations development plan in Peru. These specialists are expected to cooperate in the program on upwelling to the extent that the research fits in with their work. Communication with this group may prove to be one of the most important elements in the Peruvian study. The cooperation of FAO will be important in the Mediterranean study also.

Mediterranean Laboratories

Planning for the Mediterranean study is in a preliminary stage. However, Spain, France, and Italy have IBP projects under way in the Mediterranean that are closely related to the program on upwelling.

Spain's project is entitled "Research on Pelagic Ecosystems of Catalonian Coast." Dr. Ramon Margalef and his colleagues at the Instituto de Investigaciones are enthusiastic about the program on upwelling and plan to participate.

France's project is entitled "Primary and Secondary Production of Plankton, ^{14}C, Pigment Analysis, Physiocochemical Methods, and Population Dynamics." Professor J. M. Peres is the national correspondent for this project. The work is being carried on at a number of marine stations, including those at Marseille and Monaco.

Italy has an IBP project entitled "Seasonal and Geographical Distribution of the Primary Productivity of the Northern Adriatic Sea." Professor B. Battaglia is in charge of this work.

Italy has another project entitled "Breeding Sea-Fish with Regard for Increased Productivity of the Salt Valleys through the Anticipated Sexual Maturity." This project, directed by Professor B. Schreiber, is appropriate to the later phases of the program on upwelling. In the later phases, attempts will be made to control the species composition and to otimize the yield of lagoons and other enclosures through quasi-chemostat techniques.

In Greece, Captain Kolokythas, director of the Greek Hydrographic Service, has indicated willingness to cooperate. Resources of that service are committed to ongoing projects, and contributions to the program on upwelling would have to be related to those projects. Dr. Theano Bakakos-Kontas, of the Greek Atomic Energy Commission, has carried out a study of primary productivity in the Saranikos Gulf.

Appendix C

ORGANIZATION OF THE IBP IN THE UNITED STATES

More than 3 years of planning and coordinating activities by the U.S. National Committee, its nine subcommittees, and its several panels and ad hoc groups have culminated in a sophisticated scientific plan of integrated research and contributory research projects. The IBP organization now consists of the following groups:

- Executive Committee
- International Coordinating Committee
- Program Coordinating Committee
- Biometeorology Panel

Membership in the new organization has been approved by the National Academy of Sciences.

Executive Committee

W. Frank Blair, *Chairman*

T. C. Byerly, *Vice-Chairman*
William S. Laughlin
James V. Neel
Frederick Sargent, II
Frederick E. Smith
Roger Revelle *(Past Chairman)*
A. G. Norman *(ex officio)*

International Coordinating Committee

T. C. Byerly, *Chairman*

John L. Buckley (CE)
David Challinor (SB)
George K. Davis (UM)
Arthur D. Hasler (PF)
William S. Laughlin (HA)
E. R. Lemon (PP)
W. D. McClellan (Aerobiology)
J. L. McHugh (PM)
Jerry S. Olson (PT)
C. Ladd Prosser (EP)

Program Coordinating Committee

Frederick E. Smith, *Chairman*
(Environmental Management)
William S. Laughlin, *Co-Chairman*
(Human Adaptability)
Stanley I. Auerbach
Paul T. Baker
William S. Benninghoff
W. Frank Blair
John L. Buckley
Richard C. Dugdale
Stanley Gessel
D. W. Goodall
Robert F. Grover
C. Glen King
O. Lee Kline
F. A. Milan
Demitri B. Shimkin
George M. Van Dyne
F. John Vernberg
Donald E. Wohlschlag

Biometeorology Panel

Glenn R. Hilst, *Chairman*

Wayne L. Decker
James J. Fuquay
David M. Gates
Kenneth R. Knoerr
E. R. Lemon
Lester Machta
William E. Marlatt
Frederick Sargent, II
C. B. Tanner

Appendix D

GUIDELINES FOR PARTICIPATION IN THE INTERNATIONAL BIOLOGICAL PROGRAM

1. Individual scientists, national societies, or other scientific groups who wish to participate in the IBP should—

a. become familiar with the nature, objectives, and general scope of the IBP as outlined in Report No. 2 of the U.S. National Committee for the IBP (January 1967);

b. define precisely the relation between the project they wish to propose and those objectives;

c. establish that the projects will benefit through international cooperation; and

d. submit the proposal to a granting agency and a copy to the U.S. Executive Committee, International Biological Program, Division of Biology and Agriculture, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

2. Scientists who wish to become affiliated with an integrated research program should communicate directly with the program director and secure his comments on the proposed research before the proposal is submitted to a granting agency.

3. U.S. scientists are encouraged to review ongoing research and determine whether any projects are suitable for inclusion in the IBP.

4. The U.S. Executive Committee is not a granting agency; therefore, it can only review and evaluate proposals from the point of view of appropriateness for the IBP.

5. Proposals recommended by the U.S. Executive Committee will compete for funds with other proposals. Final judgment as to provision of funds for a proposal rests with the granting agency.

6. Proposals are to be prepared in accordance with guidelines provided by granting agencies.

Appendix E

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†Available from IBP Central Office, 7 Marylebone Road, London N. W. 1, England.

Appendix F

DIRECTORY OF U.S. AND CANADIAN SYSTEMATISTS

The Subcommittee on Systematics and Biogeography has compiled a directory of U.S. and Canadian systematists and has made available a supply of copies sufficient to meet the needs of scientists active in the U.S./IBP. The title is *Indexed List of North American Systematists Interested in the IBP.*

Those listed have expressed willingness to participate in the International Biological Program on projects that fit in with their interests.

All scientists engaged in IBP research can benefit from inventory and accurate identification of the organisms with which they work. Hence, they can benefit from collaboration with systematic botanists and zoologists. Compilers point out that the directory should be useful to program and project directors who need to get in touch with systematists qualified to participate in ecosystem and productivity field studies. They expect that it will also be an aid in locating persons with special knowledge of particular regions and environments. Further, they believe that it will facilitate communication between systematists interested in the same regions and environments; with communication established, systematists with common interests could proceed to collaborate on research projects.

Almost 1,400 systematists are included in the directory. For each there is a paragraph giving name, address, position, institutional connection, date of birth, field of study, special interests, current regional interests, field experience outside the U.S. or Canada, kinds of material he is willing to identify, and a statement on his willingness to participate in IBP systematics or ecological field studies. In addition, names are arranged under headings referring to systematic group, regional field experience, and interests.

Information was compiled from replies to questionnaires sent (1) to members of the American Society of Plant Taxonomists, the American Fern Society, and the Society of Systematic Zoology, and (2) to known systematists in the Society for the Study of Evolution, the Entomological Society of America, the American Society of Mammalogists, the American Ornithological Union, and the American Society of Ichthyologists and Herpetologists.

It should be understood that not all U.S. and Canadian systematists are included. The list is based entirely on replies to questionnaires, and hundreds of questionnaires were not returned to compilers.

A copy of the directory will be mailed, on request, to any scientist engaged in IBP research. Requests should be addressed to: Executive Secretary, U.S. National Committee, International Biological Program, Division of Biology and Agriculture, National Research Council, 2101 Constitution Avenue, Washington, D.C. 20418.

Appendix G

OFFICERS AND MEMBERS OF THE SPECIAL COMMITTEE FOR THE INTERNATIONAL BIOLOGICAL PROGRAM

Officers

President
Prof. J. G. Baer (Switzerland)

Vice-Presidents
Sir Otto Frankel (Australia)
Prof. G. Montalenti (Italy)
Prof. K. Petrusewicz (Poland)
Prof. H. Tamiya (Japan)

Scientific Director
Dr. E. B. Worthington (United Kingdom)

Members

Representing ICSU and member unions of ICSU

ICSU	Prof. D. Blaskovic (Czechoslovakia)
IUBS	Prof. C. H. Waddington (United Kingdom)
IUPS	To be appointed
IGU	Prof. C. Troll (Federal Republic of Germany)
IUPAB	Dr. A. R. Gopal Ayengar (India)
IUNS	Dr. C. G. King (United States)

Convenors of sectional committees

PT	Prof. F. Bourlière (France)
PP	Prof. I. Málek (Czechoslovakia)
CT	Mr. E. M. Nicholson (United Kingdom)
PF	Prof. G. G. Winberg (Union of Soviet Socialist Republics)
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HA	Prof. J. S. Weiner (United Kingdom)
UM	Dr. G. K. Davis (United States)

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IUCN	Prof. J. G. Baer (Switzerland)
IUAES	Prof. J. Hiernaux (Belgium)

Representing scientific committees of ICSU

SCAR	To be appointed
SCOR	Dr. O. H. Oren (Israel)

Elected members
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Prof. A. E. Bychowsky (Union of Soviet Socialist Republics)
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Prof. H. Tamiya (Japan)
Dr. H. Thamdrup (Denmark)
Dr. C. A. du Toit (Republic of South Africa)
Dr. M. Vannucci (Brazil)

Appendix H

COUNTRIES PARTICIPATING IN THE IBP, WITH CHAIRMEN OF NATIONAL COMMITTEES

Argentina	Prof. O. Boelcke
Australia	Sir Otto Frankel
Austria	Prof. W. Kühnelt
Belgium	Prof. P. Duvigneaud
Brazil	Prof. A. Cury
Bulgaria	Prof. I. Pashev
Canada	Dr. T. W. M. Cameron
Ceylon	Prof. B. A. Abeywickrama
Chile	Dr. F. di Castri
China, Republic of	Dr. Jong-Ching Su
Colombia	Dr. L. E. Mora
Congo	Prof. A. F. de Bont
Czechoslovakia	Prof. I. Málek
Denmark	Dr. H. M. Thamdrup
East Africa	Dr. W. B. Banage (acting)
Kenya	Dr. R. S. Odingo
Tanzania	Mr. A. S. Msangi
Uganda	Dr. G. H. Kiwuwa
Ecuador	Dr. M. Acosta-Solis
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France	Prof. Th. Monod
Germany, Democratic Republic of	Prof. H. Stubbe
Germany, Federal Republic of	Prof. H. Ellenberg
Ghana	Dr. A. J. E. Bucknor
Greece	Prof. G. Athanasiades Novas
Hungary	Prof. J. Balogh
India	Prof. B. R. Seshachar
Indonesia	Dr. O. Soemarwoto
Ireland, Republic of	Mr. P. M. McDonnell
Israel	Prof. J. Magnes
Italy	Prof. C. Barigozzi
Japan	Prof. H. Tamiya
Korea, Republic of	Prof. Yung Sun Kang
Malaysia	Enche K. D. Menon
Mexico	Dr. G. Soberon
Netherlands	Prof. C. J. Vervelde
New Zealand	Prof. G. A. Knox
Nigeria	Prof. C. I. O. Olaniyan
Norway	Prof. R. Vik
Philippines	Dr. D. V. Villadolid
Poland	Prof. K. Petrusewicz
Rhodesia	Prof. E. Bursell
Romania	Prof. N. Salageanu
South Africa, Republic of	Prof. C. A. du Toit
Spain	Prof. A. Carrato
Sweden	Prof. C-G. Heden
Thailand	Lt. Gen. P. Salvidhannides
Tunisia	Mr. El Fekkih
Union of Soviet Socialist Republics	Prof. B. E. Bychowsky
United Arab Republic	Dr. Hussein Said
United Kingdom	Prof. A. R. Clapham
United States	Prof. W. F. Blair
Uruguay	Prof. C. Estable
Venezuela	Prof. F. H. Weibezahn
Vietnam, Republic of	Mr. Pham-Hoang-Hô
Yugoslavia	Dr. M. Todorovic