1025-A
KANSAS STATE UNIVERSITY LIBRARIES
Y4.Sci2/90-2/4
Y 4
.Sci 2
90-2/4
Storage

H.J. RES. 1240—INTERNATIONAL BIOLOGICAL PROGRAM

GOVERNMENT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

NINETIETH CONGRESS

SECOND SESSION

MAY 1 AND 2, 1968

[No. 4]

Printed for the use of the Committee on Science and Astronautics

U.S. GOVERNMENT PRINTING OFFICE
95-895 WASHINGTON : 1968

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

COMMITTEE ON SCIENCE AND ASTRONAUTICS

GEORGE P. MILLER, California, *Chairman*

OLIN E. TEAGUE, Texas
JOSEPH E. KARTH, Minnesota
KEN HECHLER, West Virginia
EMILO Q. DADDARIO, Connecticut
J. EDWARD ROUSH, Indiana
JOHN W. DAVIS, Georgia
WILLIAM F. RYAN, New York
THOMAS N. DOWNING, Virginia
JOE D. WAGGONNER, JR., Louisiana
DON FUQUA, Florida
GEORGE E. BROWN, JR., California
WILLIAM J. GREEN, Pennsylvania
EARLE CABELL, Texas
JACK BRINKLEY, Georgia
BOB ECKHARDT, Texas
ROBERT O. TIERNAN, Rhode Island
BERTRAM L. PODELL, New York

JAMES G. FULTON, Pennsylvania
CHARLES A. MOSHER, Ohio
RICHARD L. ROUDEBUSH, Indiana
ALPHONZO BELL, California
THOMAS M. PELLY, Washington
DONALD RUMSFELD, Illinois
EDWARD J. GURNEY, Florida
JOHN W. WYDLER, New York
GUY VANDER JAGT, Michigan
LARRY WINN, JR., Kansas
JERRY L. PETTIS, California
D. E. (BUZ) LUKENS, Ohio
JOHN E. HUNT, New Jersey

CHARLES F. DUCANDER, *Executive Director and Chief Counsel*
JOHN A. CARSTARPHEN, JR., *Chief Clerk and Counsel*
PHILIP B. YEAGER, *Counsel*
FRANK R. HAMMILL, JR., *Counsel*
W. H. BOONE, *Chief Technical Consultant*
RICHARD P. HINES, *Staff Consultant*
PETER A. GERARDI, *Technical Consultant*
JAMES E. WILSON, *Technical Consultant*
HAROLD A. GOULD, *Technical Consultant*
PHILIP P. DICKINSON, *Technical Consultant*
JOSEPH M. FELTON, *Counsel*
ELIZABETH S. KERNAN, *Scientific Research Assistant*
FRANK J. GIROUX, *Clerk*
DENIS C. QUIGLEY, *Publications Clerk*

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT

EMILIO Q. DADDARIO, Connecticut, *Chairman*

J. EDWARD ROUSH, Indiana
JOHN W. DAVIS, Georgia
JOE D. WAGGONNER, JR., Louisiana
GEORGE E. BROWN, JR., California
WILLIAM F. RYAN, New York

ALPHONZO BELL, California
CHARLES A. MOSHER, Ohio
DONALD RUMSFELD, Illinois
D. E. (BUZ) LUKENS, Ohio

CONTENTS

STATEMENTS

APPENDIXES

CONTENTS

INTERNATIONAL BIOLOGICAL PROGRAM

WEDNESDAY, MAY 1, 1968

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10:30 a.m., in room 2325, Rayburn House Office Building, the Hon. Emilio Q. Daddario (chairman of the subcommittee) presiding.

Mr. DADDARIO. This meeting will come to order.

Our witnesses this morning are Dr. W. Frank Blair, Chairman, U.S. National Committee for the IBP, and professor of zoology, at the University of Texas; Dr. Ivan L. Bennett, Deputy Director of the Office of Science and Technology; and Dr. Leland J. Haworth, Director of the National Science Foundation.

Our witnesses tomorrow will be Dr. Philip Handler and Dr. Harve J. Carlson.

Last year, at the direction of Chairman George Miller, this subcommittee investigated the International Biological Program. We did that with a supporting resolution by the chairman, which was House Concurrent Resolution 273.

That inquiry lead to a 4-month period of investigation. At the conclusion of this investigation, the subcommittee was convinced of the importance of the International Biological Program, both for its own sake and for its great significance with respect to the natural environment of the earth. At the same time we felt that the legislative adequacy of that resolution was not particularly effective.

In March of this year, the subcommittee issued a report which contained some critical observations of the program as it currently exists plus recommendations for getting the research phase underway and operative.

Subsequently, and in accordance with the subcommittee's findings, the chairman introduced a new resolution, entitled House Joint Resolution 1240. The current hearings are being held on this resolution.

I should like to emphasize we are not now considering the merits or the desirability of the IBP itself. That determination has already been made. So far as the subcommittee is concerned, the IBP is a promising attempt to deal with an urgent problem; namely, the understanding of our planetary ecology. Without such understanding, we are in grave danger of an accelerating deterioration of the ecosystems on which all life depends.

What we are concerned with here is the method of implementing the U.S effort. How can we give the program the support it must have to be effective?

House Joint Resolution 1240 is similar to the previous one in many respects. It differs mainly in that it would authorize specific sums to be used for the IBP through the National Science Foundation during fiscal year 1969 and would provide general authorization for the following 4 years.

We recognize that there are inadequacies in this resolution. This is really the reason we are having these hearings. It does not spell out the role of the National Committee, for example, nor its relationship to the Science Foundation. It does not specify the responsibilities of the various coordinating agencies. Moreover, we recognize that the budget item for contingencies which is used as the basis for the authorization is not an existing fund from which available money can be drawn. It is simply an estimate by the administration of what its supplemental needs are likely to be.

Therefore, we do not regard House Joint Resolution 1240 before us for discussion as a finished product. We expect it will need change and we hope for some constructive suggestions in that regard. We also believe that if, in fact, the IBP is as important as our inquiries suggest and as we have been advised by most of the witnesses before us, it is incumbent upon us to find a way to implement it. That is our purpose today.

We had thought it would be helpful to have all of our witnesses come to the table at the same time. It may be necessary for us to inject ourselves from the committee point of view by questions at any time during the course of the discussions you gentlemen have to offer us this morning.

We are pleased, of course, to have you here and the committee apologizes for having held you up for a while because of a special subcommittee chairmen meeting in preparation for our authorization hearings tomorrow on the space program.

We will proceed then with Dr. Blair. Dr. Blair, we are happy to see you here this morning.

STATEMENT OF DR. W. FRANK BLAIR, CHAIRMAN, U.S. NATIONAL COMMITTEE, INTERNATIONAL BIOLOGICAL PROGRAM

Dr. BLAIR. Thank you, Mr. Chairman.

Members of the committee and guest audience.

I have a prepared statement which has been submitted and I would like to put this into the record.

(Statement for the record by Dr. W. Frank Blair, Chairman, USNC/IBP, is as follows:)

The pressing need for support of the IBP has been recognized by this subcommittee in its recent report of the hearings on the IBP resolution. Furthermore, the recognition of the urgent needs for the kinds of analyses that form the core of the US/IBP participation have been recognized by the Executive Branch in a memorandum to the President, dated January 24, 1968, and signed by Dr. Donald F. Hornig, Director, Office of Science and Technology, and by Mr. Charles L. Schultze, Director, Bureau of the Budget. Therefore, there seems to be no need to direct my statements to a support of the reasons for strong U.S. participation in the IBP. Consequently, I will address my remarks to the urgency of funding the U.S. effort under the IBP at the earliest possible time.

I would like to speak to three main questions: (1) Pertinence of the 4 problems identified in the Subcommittee Report (p. 11) to the feasibility of immediate

funding, (2) the reasons why the U.S. effort under IBP should be started as soon as possible, and (3) the expressed needs of the US/IBP for FY69.

I. Major Problems Identified by the Subcommittee.

A. "The loose structure and organization of the IBP administrative machinery."

This no longer seems a valid criticism as a complete restructuring of the U.S. machinery has been recommended to the National Academy of Sciences-National Research Council, and has been approved in the Division of Biology and Agriculture. A 5–6 man Executive Committee becomes the prime executive unit of the US/IBP, answerable to the Division of Biology and Agriculture. Under this there is a 9–10 man committee charged with developing and maintaining coordination of the research efforts of the U.S. program with SCIBP and with other national programs. This committee will have a representative from each of the nine areas represented by the Chairmen of the now defunct subcommittees, which areas correspond to the 7 SCIBP Subcommittees plus the two which were added under the U.S. program.

Another committee comprised of the directors of the integrated programs will have prime concern for integration and coordination of the U.S. Program and will interact with the SCIBP-relations committee.

Integrated programs that have not yet had review by the Executive Committee for pertinence to the objectives of the IBP and for scientific merit will receive review by this committee, which will use *ad hoc* reviews where necessary. This will prevent the mutual embarrassment of having IBP pertinent, but scientifically weak, proposals being submitted to the funding agencies under the IBP label. This is in no way a usurption of the right of review and rejection by the funding agencies.

B. "An inadequate and unrealistic mode of funding."

The proposal made by the subcommittee for funding the U.S. participation in the IBP through a line item in the NSF budget would solve this problem, and I personally think that this is the cleanest kind of solution to this problem.

C. "The shortage of trained manpower."

Experience in such developing programs as the Grasslands Biome Study and the study of Convergent and Divergent Evolution indicates that there presently exists a sufficiency of personnel to mount these programs now. At the Caracas Conference to plan the latter program, 64 people, almost equally divided between North and South America, involved themselves in this program. Since then, several others in both hemispheres have become involved as they learned of the program.

Increased training of scientists to participate in these programs is indicated and is a natural corollary of the planned programs. However, lack of trained people is presently no impediment to immediate mounting of these programs.

D. "Lack of Public Understanding and of Firm Endorsement by Congress and the Executive."

As indicated earlier, the kinds of things that comprise the main thrust of the IBP in the U.S. have been endorsed by the Executive. In the Congress, the IBP provides an umbrella for possible activities related to environmental quality and to abatement of environmental pollution that have been called for by legislation introduced into both the House and the Senate. In view of this concern in both legislative bodies, it is difficult to see how the U.S. effort and the IBP could fail of enthusiastic support in both houses.

II. Reasons Why We Need To Start as Soon as Possible.

A. Planning by the U.S. participation in IBP has reached the stage where action is necessary or there will be a severe loss of momentum.

B. Many scientists have made plans to participate; the time to get into action is past due. They will understandably turn to other things if the program cannot be started.

C. Delay longer will risk our world leadership. The sophistication of our program has evoked admiration of other IBP participant countries. We have much to lose if our government should now fall down on the financing of this effort. One result of the Third General Assembly of IBP at Varna, Bulgaria was the formation of a committee, with a Swede (De. Bengt Lundholm) as Chairman and a Russian (Dr. J. Winberg, USSR) and myself to explore development of a world net for monitoring environmental baselines, pesticides, heavy metals, CO_2, etc. at IBP stations. Such an effort might be endangered if we drag our feet.

D. Lastly, there is a real environmental crisis. It has been identified by this subcommittee in reports of hearings on IBP and in reports on hearing on environmental pollution and related matters. I do not wish to be dramatic or alarmist in saying that the time is frighteningly late to be undertaking an understanding of the functioning of the ecosystems of which man is a part and to the malfunctioning of which he is the greatest contributor.

E. One of the 5 official years of IBP will have passed by the beginning of FY69. This is one year lost of the 5 in which an international program for coordination and prosecution of environmental biological studies is certain of existence. Possibly the Biosphere Program under UNESCO will take over where IBP leaves off. But I would regard this as far from certain if IBP fails in the richest and scientifically most advanced country because of failure to provide adequate support—a sum that represents a minuscule fraction of the national budget.

The preceding statements as to how much money was needed and could be effectively utilized in FY69 were made at a joint meeting of the U.S. Executive Committee for IBP and the program directors for the integrated programs. It is noteworthy that the people directly concerned with planning and supervision of the integrated programs have indicated the need in FY69 for more than the maximum amount of funds provided for in the proposed legislation. However, the $5 million would get the U.S. IBP well into the action phase in FY69, and the amount of effort in FY69 obviously will have to be tailored to what is available.

Dr. BLAIR. I have come with the intention of speaking to three main questions that I think are of interest to the committee. As Mr. Daddario has indicated, I do not feel IBP is on trial here, and I am not going to speak to this; but I would like to speak to three main questions.

The first is the questions that were raised on page 11 of the subcommittee report pertinent to problem areas that they saw in our IBP efforts. Secondly, I would like to speak to reasons I feel that it is very important that IBP participation in this country be funded at some level that will permit it moving into the action phase as soon as possible. Lastly, I would like to give some figures on what our organization feels could be used usefully in fiscal 1969.

First, I would like to speak to the four problems which were identified by the subcommittee. The first refers to the "loose structure and organization of the IBP administrative machinery."

At the time the report was written, this was a valid criticism. I believe our organization has reacted to this and to other similar criticisms to the extent we now have completely restructed our organization into what appears to be an efficient operational body, and I would like to speak to this in a bit of detail since I think it is a very pertinent matter.

The recommendation has been made to the National Academy of Sciences-National Research Council and has been approved in the Division of Biology and Agriculture. We anticipate that it will not be treated otherwise and will be approved farther up the line that the following organization operate our USA/IBP effort.

There will be a five- to six-man Executive Committee which will be the prime executive committee for the US/IBP. This Executive Committee will be answerable to the Division of Biology and Agriculture and to the Academy. Actually, we now have a five-man committee consisting of myself, Dr. Cain and Dr. Byerly, who are the co-chairmen, Dr. Fred Smith who is heading up one of our main thrusts in the US/IBP effort, and Dr. Fred Sargent who represents the human adaptability side of our U.S. effort, which is the other main thrust. This will be the operational committee that will actually be the executive group.

Now, in essential replacement of the old, very large and very sprawling U.S. National Committee, which actually has done the job of planning, which is now essentially completed, we have recommended a nine- to 10-man committee that we are calling the International Coordination Committee. In other words, this committee will coordinate with the Special International Committee for the IBP. This would have nine to 10 people representing the subject areas of the international committees—the seven that the international organization recognizes and the two we have added in our own program (the environmental physiology and the systematics and bio-geography committees).

This committee would be charged mainly with developing international coordination of our efforts that emerge from our own program.

The people we are thinking about as members of the committee are people who already have international contacts, who have international recognition in their fields, and who would be effective and interested in increasing the international coordination.

Another committee—and both of these committees, this one and the one I will mention next are, of course, answerable to the Executive Committee and on up through the channels—will be made up of the program directors for the integrated programs. These are the people who are active and who are heading up our major efforts in the US/IBP. They would be mainly operating to coordinate the entire program efforts in the U.S. and to interact with the International Coordination Committee to feed their efforts into the international effort, too.

This gives us an entirely different kind of structure than we have had. It is, we think, a much more reasonable, manageable, and effective kind of structure. I might say parenthetically that the program directors are meeting here, yesterday and today, to take an *ad hoc* look at the present status of our program. I will come back later to some figures they gave me yesterday to bring to this committee.

Review of the integrated programs as they come in for funding will be by way of the executive committee, which will use *ad hoc* committees if it is necessary. We will not have the large number of standing committees that we have had in the past.

This is where we stand now in our organization, and I have no doubt this will be approved at the highest level in the Academy, and this is the way we are expecting to operate.

The second question raised was one of "an inadequate and unrealistic mode of funding." Of course, that is what this meeting is all about, I believe. My own position is that the proposal that IBP be funded mainly through a line item in the NSF budget is the cleanest, simplest, most realistic way to handle this funding.

I think I need say no more about this unless there are questions that come up about it.

"The shortage of trained manpower"—our experience in the development of our integrated programs (the large programatic programs that are really the core and heart of our IBP participation in this country) has been otherwise than to show that we are too short of manpower to get these programs started.

This is not to say we have enough manpower that we can leave the training aspect out, but what it does say is that we have enough man-

95-895—68——2

power of interested people to "get the show on the road," so to speak, now. As one example from my own personal experience, we held a conference in Caracus, Venezuela, to plan one of the programs that is very strongly Latin American, and international, in its cooperative relations, and we now have 64 people involved in this program. About half are in Latin America and half in the United States, with a few in other parts of the world, as a result of this planning.

Since that time, a number of people have asked to be included on the basis of the information that has been disseminated about this program. Now, this, I think, is illustrative of the kind of manpower that is around, ready to participate in these programs. The results were even more impressive with the plannings for the grasslands program that is a part of our main thrust, the ecosystems studies where I think something like 200 people indicated an interest. This has been sifted down to a degree and the people in NSF can speak to that better than I can.

There is a very large number of people to get this program going. This does not mean that we need disregard training as part of the program. I think training is a corollary of our whole IBP efforts. We do need more ecologists, but we do have enough people now to start these programs at a reasonable level.

Mr. BROWN. I am concerned about the relative effort, measured by man-years that would be involved in the planning of this program, I accept the fact that you have qualified people who can engage in planning activities which is normally a portion of the effort of the individuals.

But as a program develops in accordance with these plans, will it or will it not require the assignment of full-time people who can engage in what you might call the operations aspect of this thing?

Dr. BLAIR. Our planning does involve this and certainly a part of the cost of the IBP will be people who do this sort of thing.

Mr. BROWN. The question then arises, do we have people at the various levels of professional competence to fit into a full-time operating program? Does your remark with regard to the adequacy of manpower for the planning purposes apply equally well to this later phase?

Dr. BLAIR. Perhaps I was misunderstood a little bit, Mr. Brown. In the planning phases, of course, we did, you might say, flush out the people who had a real interest in it. What I am saying is there are 200 people who had a interest in actually participating in the research phase of this program.

Now, if we develop the ecosystems studies, as we expect, I am sure we are going to run into shortages. I do think this will happen, when we launch the rain forest study. In some of these areas we are going to be short of manpower. I don't think we could say we have enough ecologists in any one of these areas, but I do say we have enough to mount an ambitious and sophisticated program now with the idea that the training aspect is going to beef this up as we go along.

Mr. DADDARIO. Dr. Blair, following Mr. Brown's question, do your observations on that include also the South American participation or are you talking just about ourselves?

Dr. BLAIR. I am very happy to speak about the South American participation. The people I am talking about in South America, about 35 plus people who have become involved in this program, are the

cream of the biologists with that kind of interest in Latin America. There is a very great shortage of ecologists in Latin America, and I would visualize a very important contribution of IBP efforts in the United States as the improvement in this area of biology in Latin America, because I think we have a very vested interest in promoting knowledge of the tropical rain forest and of what is happening to the environment generally in Latin America.

I was in Colombia about a month ago and I saw some of the most devastated country I have ever seen, in the Cauca Valley, which is the part of Colombia of which they are so proud. They have chopped down the trees off the hills to supply pulp mills. They have dumped the effluents into the rivers and the rivers are as polluted as any of our rivers. They have a great cane industry there. The effluents from the cane mills are dumped into the rivers. This adds to the pollution and it's a really depressing part of the world.

Mr. BROWN. Have you ever been to northern Maine?

Dr. BLAIR. This is just as bad, I believe. They are doing exactly what we did 100 years ago and doing it with more modern equipment. I don't like to digress, but I also know——

Mr. DADDARIO. You call that progress, Dr. Blair?

Dr. BLAIR. I don't, but some people do. The same thing is going to happen in the rain forest. So I think we have a very definite interest in tropical ecology and also in the increased competence in tropical ecology by the people in Latin America. If they put in sawmills to cut down the Amazon rain forest, which is actually happening, I think we are all going to suffer around the world, because the tropical ecology is such we are not going to have a great productive plain where the Amazon Basin is. We can expect to have a desert. We certainly need people in Latin America who understand this. I am digressing very considerably from my subject, I am afraid.

The fourth problem area was the "lack of public understanding and of a firm endorsement by Congress and the executive branch." I feel that certainly the kind of support, the kind of interest, that has been shown by this subcommittee, the kind of interest in the things that IBP has mainly focused on, also has been expressed by the executive branch. I am referring to the recent memorandum from Dr. Hornig to the President, which stresses the need for study of natural areas, for the preservation of natural areas, and so forth. These to me indicate philosophical support by the executive branch, at least for the objectives of IBP.

Now, the second question I would like to speak to is the one of why we do need to get started now, and I have about five points in all that I will make very quickly. I think they are all points that should be taken into consideration.

The planning of the United States for participation in IBP has now reached the stage where action is necessary soon, or we are going to lose momentum. The momentum is rather considerable right now. People are interested. They are making plans for participation, and I think we will definitely lose momentum if we do not get more of the research that has been planned now into the action stage. Many of the scientists who have made plans to participate are going to have to turn to other things, the realities of scientific existence being what they are, if they don't get support.

Just having recently returned from the General Assembly of IBP in Varna, Bulgaria, where 37 countries were represented, I feel strongly that the United States is going to lose its world leadership if we don't get out program developed rather rapidly. It was very obvious at Varna that the whole world looks to the United States in this field for leadership. A part of this has been the admiration they have shown for this program of ours because it does go beyond just reclassifying a lot of ongoing research and calling it IBP. It is definitely a new kind of biology which is admired by these other countries, and I think we are going to lose our leadership unless we show that after having planned this we can go ahead and "get the show on the road."

One of the things that I think is of interest here that came up at the meeting in Varna, Bulgaria, was the formation of a small three-man international committee of which I am a member to look into the possibility and the problems of establishing a world network for baseline monitoring of our environment in connection with the IBP stations. This came orignally from the Swedish delegation. It found very enthusiastic reception by the Russian delegation and by the United Kingdom delegation, and we supported it strongly because it fits our whole thinking in this country. We recognize the need for providing the kind of baseline information that has been requested many times recently by the Congress with respect to what is happening to the quality of our environment.

If we drag our feet, however, we risk our chance of being influential in developing this kind of operation on an international scale. Then I would also say without being either an alarmist or dramatic that I feel there is a real environmental crisis. The things I just spoke about in Latin America as well as the things that are happening here put pressure on us, I think, to begin to understand the functioning of our ecosystems as quickly as we can. I don't want to be dramatic, but I really think we are reaching the stage where time is running out on us, and I think this committee also has expressed these sentiments very strongly.

I would also say that 1 of the 5 official years of IBP will have passed by the beginning of fiscal year 1969. A year has gone of the 5-year period in which there is a certainty of an international body to overview this international effort.

Now, I believe that something will follow IBP. There is a thing now called the Biosphere Conference under UNESCO that is looking to the possibility of taking up where IBP leaves off as an international project. But I think that if we fall down, this may well jeopardize what might come out of this as an international look at the environment in which we live.

Mr. BROWN. May I inquire at this point, is the Biosphere Conference you refer to the one scheduled for September in Paris?

Dr. BLAIR. Yes. In Paris.

Now, lastly I would like to give you some figures for what they are worth that came out of our meeting yesterday. This is an estimate made in response to my request for statements of the amount of money that the program directors actually felt they needed and could use usefully in getting their programs in action or increasing the activity in their programs in fiscal year 1969 and the amount of new money

they said they could use. They said they could use usefully a total of $7½ million, rounded off.

We also asked for estimates of whether or not reductions in this amount would seriously impair the programs. In essentially all cases it was said that "we can start at a lesser scale depending on what we have to work with." The total sum is what they said they really could use. This is more than your resolution calls for, and I think—putting in some kind of factor to account for the enthusiasm of scientists when they talk about money—they could effectively use money within the limits that have been set in this resolution. They think they could use more, but I have no doubt that $5 million could be effectively spent in fiscal 1969 if it were available; and I do feel this would be very important to maintaining the momentum of the program if this money can be found.

We now have many people tooled up, so to speak, ready to go, and we are in a real bind for money. This includes one of the most appealing programs of all in terms of our problems in the country—the migrant populations program dealing with the underprivileged groups that are moving from underprivileged areas in which they are underprivileged to our cities where they are still underprivileged, at least where they are still under stress. We have not been able to get funding to get this very important program going this year. So far we haven't. We have been trying hard, but we have not been able to do it.

Mr. BROWN. Do I understand this is a part of the ecological program?

Dr. BLAIR. This program deals mainly with the Negroes from the South who are moving into the large cities in the North where they are again under stress, from poverty-stricken areas in the South to large cities where they are still under conditions of stress. This program is designed to take an ecological look at their situation.

Mr. DADDARIO. This is one of the programs which we felt was properly put together last year and which we believed you could have gone ahead with at that time.

Dr. BLAIR. We feel we can go ahead and yet we have not been able to obtain funding for this program.

Mr. DADDARIO. How does the $7.5 million which you believe is necessary for all your programs, get projected into the migrant area?

Dr. BLAIR. Actually what we are talking about is a minimum $291,000 for fiscal 1969, which is the figure I was given by the representative of this program yesterday. This is a minimum.

Mr. BROWN. May I inquire if there is a similar component in Latin America where they have a problem with the Indians migrating to the cities?

Dr. BLAIR. There certainly are similar components. We discussed yesterday the possibility that something could be worked out to cooperate particularly in Peru where the Indians are moving out of the high country down into places like Lima, and they are facing physiological stress as well as sociological stress because they are changing their environment, coming out of the uplands into the lowlands. I was not aware of this, but I am very much aware of the problems in Brazil where the people from the northeast of Brazil are moving into the large cities like Rio and São Paulo, and there again creating the ghettos where they are very very stressed. They are very

very poor people. In these large cities right up behind a new modern office building will be a hillside full of huts with people who have moved in.

Mr. BROWN. I would like to know what kind of research is involved here. The question of sociological stress is not one that has come to my attention particularly before; yet I see it as being a problem not only with migrants, but it may be a problem with a large part of our privileged population. It is an aspect of ecology which I think might be very rewarding to investigate further.

Dr. BLAIR. As a resident in a relatively small city, I am stressed when I come to Washington or to New York or Chicago.

Mr. BROWN. When you consider just the microcosmic aspects of the transition that the human race has made from small group living to the kind of living we have now within a generation or two, it would seem reasonable to expect some major stress; but I have never seen any emphasis on research to measure this.

Dr. BLAIR. I would agree.

That is my statement, Mr. Chairman.

Mr. DADDARIO. Could you provide for the record the breakdown of that $7½ million?

Dr. BLAIR. I will. Actually it was inadvertently omitted from this thing which was typed and duplicated this morning, having come out of the meeting yesterday. We will do that, yes.

(Information requested follows:)

ADDENDUM TO STATEMENT OF W. FRANK BLAIR

Three 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 programs and contributory research projects designed to generate information and data that will contribute to solution of some of the problems facing mankind.

Approximately one year ago members of the National Commitee, Executive Committee and the NAS–NRC commenced to give serious consideration to the kind of structure and organization needed for the management of the operational phase of the IBP which was to begin in July of 1967. In October 1966, members of the subcommittee had directed their attention to the management of integrated research and by the beginning of 1967 one management proposal had been submitted to the National Science Foundation for funding (Analysis of Ecosystems).

Intensive efforts during 1967 and 1968 have led not only to a new stream lined management structure within the NAS–NRC for the national and international aspects of the IBP, a management structure for research at the laboratory and field level, but also to a more sharply defined research program.

The original planning and coordinating structure has been reduced from one consisting of 94 persons and approximately 14 elements to the present one of approximately 24 persons distributed among (1) a five-man executive committee, (2) a nine-man international coordinating committee, and (3) a committee consisting of research managers.

In preparation for a two-day meeting held on 30 April and 1 May 1968, Dr. James V. Neel, Chairman, Department of Genetics and Dr. Frederick Smith, School of Natural Resources, both of the University of Michigan, were given the assignment of integrating the human and environmental programs of the U.S. scientific program. Weeks of intensive preparation by Drs. Neel and Smith culminated in the resolution of the U.S. program into two major components: (a) problems of human adaptability and (b) problems of environmental management.

As a result of meetings, conferences and workshops held in 1967 and 1968, the research managers on 30 April-1 May submitted ready-to-go research programs totaling 7.5×10^6. However, there is recognition and acceptance of the need to scale the research to funds made available.

Universities in the U.S. associated with the IBP have expressed a willingness to administer the funds and assist in other useful ways. Each program director has, or will have, when funds are made available, a scientific coordinator and an advisory staff.

The sum of 5×10^6 distributed among the several research programs should not create unusual management problems.

There is nothing new in the management of these researches because in addition to the management by the research directors there will be the normal fiscal review by the granting agencies.

Each of the programs for which funds are requested have research management staffs in being or committed and proposed for support when funds become available. An example of the management structure now carefully designed on one major effort is shown on page 52 of the report entitled "The International Biological Program—Its Meaning and Needs," by the House Subcommittee on Science, Research and Development.

Minimal needs for implementation of the IBP effort of the U.S in FY 1969 are:

ENVIRONMENTAL

	Thousands
Analysis of ecosystems	$1,500
Convergent and divergent evolution	500
Phenology	185
Physiology of colonizing species	560
Aerobiology	485
Hawaiian program	500
Biogeography of the sea	583
Nitrogen balance	380
Crop production under stress	[1] 500
Biological control	1,661
Marine mammals	46

MAN

Ecology of migrant populations	291
Eskimo program	200
Genetics of the American Indian	[1] 500
Biology of high altitude	850
Nutrition	[1] 1,580
New money total	7,741

[1] Already funded for fiscal year 1969, and not included in new money total.

Mr. LUKENS. What would be the largest sum of money and where would that be directed.

Dr. BLAIR. It is fairly evenly distributed. Actually the largest sum would go into the very large ecosystems program which is really the core of our effort.

Mr. DADDARIO. Dr. Blair, where do we stand in relation to other countries? What have they done to support themselves? How will they proceed in the cases that we go ahead or not?

Dr. BLAIR. I would answer that mainly, on my experience at the international conference in Varna, by saying that most of the countries have identified a very considerable amount of their on-going research as IBP. Some have not gone beyond this. Some like the United Kingdom, the U.S.S.R., and the Scandinavian countries, which have joined together in a consortium for IBP, have programs that will go whether we lead or not.

But the point is these people all look at our U.S. program. Their attitude is: "This is what we would like to do. We don't feel we have the manpower and the money to do it, but you are setting the right pattern that we would like to follow if we could." This is what I mean by world leadership. They are looking to us to set the pattern.

Mr. DADDARIO. It wouldn't be sufficient if we were to follow the same procedure by having itemized on-going programs under IBP which probably would be going on anyway.

Dr. BLAIR. If we did nothing but this, I dont think they would be looking up to us as setting any kind of pattern, because this is the pattern they are following now in many countries.

Mr. DADDARIO. Is there any country which is identifying this other than by on-going?

Dr. BLAIR. I didn't want to indicate there are none. There are many things that come from the IBP efforts on an international scale, and over and above this identification of on-going research. Several countries have developed programs with neighboring countries. The Scandinavian countries are working as a unit. Some of the East African countries are working as a unit; Tanzania, Kenya, Uganda are working together. This is a kind of cooperation that hasn't existed before.

In addition, there are programs that are new programs involving the advanced countries like the United States, the United Kingdom, and the undeveloped countries in Africa, Latin America, southern Asia, Malaysia, for example.

I did not want to say IBP internationally is entirely based on on-going research. These cooperative programs have emerged, and I do believe our own U.S. organization must make its influence felt more in the world in the international effort in increasing this aspect of IBP; and certainly, as long as I am chairman of this committee, this is what I am going to push for, for continued efforts to extend our world leadership. There is a problem sometimes with Europeans. There are people in England and Western Europe who feel still that the world rotates around that little sector of the globe, but, nevertheless, we can make our influence felt much more in the world than we have in influencing the whole international program, and this is one of the things we wish to do.

Mr. DADDARIO. A year has passed. Do you indicate by the formation of unified groups of countries in East Africa and in the Scandinavian countries that they are actually coordinating activities where their peoples are working jointly in projects or is this at the present time a paper organization through which they would lead to such activity?

Dr. BLAIR. We have, I think, some of these at each end of the spectrum. Certainly the Scandinavian countries are working together. They have organized; they are actually working on a Scandinavian program. In East Africa much of it is on paper, but they are working in this direction.

Mr. DADDARIO. Your point then is that if we give the kind of leadership you are asking for we would give greater impetus to these other activities?

Dr. BLAIR. Absolutely.

Mr. DADDARIO. And perhaps develop within them a greater sense of participation?

Dr. BLAIR. Yes; I think this is absolutely certain; and I think, if we don't do it, there is no country strong enough to do it.

Mr. BROWN. Dr. Blair, may I inquire as to which nations speak to us by their absence.

Dr. BLAIR. I would say the only nation that is really conspicuous by its absence is Red China. Now, the Communist nations generally

are very much into it. Russia has a very good program. I would say their program is, even though it has been very recently developed, one of the better ones.

Mr. DADDARIO. Have you issued them an invitation to which they failed to respond?

Dr. BLAIR. We haven't yet; but actually the meeting in Varna was attended by a very large an very friendly and very participating Russian delegation of eight people.

Mr. DADDARIO. Red China was absent because nobody asked them to the party?

Dr. BLAIR. This I cannot answer. I simply do not have the answer. The Communist nations generally are in it. The central European and Eastern European nations are in it.

Mr. BROWN. Dr. Blair, is the breakdown basically those nations which are in the U.N. as compared to those who are not, Red China, North Vietnam, and North Korea?

Dr. BLAIR. Yes; this is pretty much the same. I do not know enough about the history of that international aspect to really answer your questions meaningfully, but it is essentially the U.N group of nations.

Mr. BROWN. May I ask one other thing with regard to the leadership which the United States can give. There are certain aspects which would cut across the board such as the overall worldwide data transmission and storage. These ultimately are going to have to be done in rather a sophisticated way.

Is that an area in which the United States may possibly provide an integrating function or a leadership function?

Dr. BLAIR. I think this is one of the areas in which we can definitely do it. We are working in this direction now.

Mr. BROWN. I can visualize data collection systems, based on our satellite systems, and storage systems, based on some of the more sophisticated computer operations, that might provide a service to the world.

Dr. BLAIR. This is certainly in our thinking and planning.

Mr. DADDARIO. Mr. Lukens.

Mr. LUKENS. No questions, Mr. Chairman.

Mr. DADDARIO. Our next witness will be Dr. Ivan Bennett, and you have a prepared statement, Dr. Bennett. You can proceed with it any way you like.

Dr. BENNETT. Mr. Chairman, I would prefer to read the statement.

STATEMENT OF DR. IVAN L. BENNETT, JR., DEPUTY DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. BENNETT. Mr. Chairman and members of the subcommittee: It is a pleasure to appear before you for further discussion of this country's participation in the International Biological Program (IBP).

Last May at the subcommittee's initial hearing on House Concurrent Resolution 273, I pointed out that since shortly after the formal decision by the National Academy of Sciences in 1965 to appoint the U.S. National Committee for the International Biological Program (USNC/IBP), the Office of Science and Technology (OST) has en-

95-895—68——3

dorsed and supported U.S. participation in this international endeavor. This position, which remains unaltered, is based upon the firm conviction that the IBP, in its general conception, offers the potential for great expansion of basic knowledge in areas where the need for better scientific understanding has become grossly evident and widely recognized in recent years. I might add that the broad realization of this need is attributable, in no small part, to the efforts of this subcommittee. As I stated last year:

> . . . to elaborate before this subcommittee on the subject of the acute problems, both national and global, involved in intelligent use and conservation of all resources, living as well as inanimate, is rather like bringing coals to Newcastle.

I then described to the subcommittee the two general reasons for OST's opposition on the IBP:

> First, this is a program originated by scientists from several countries and, if pursued as planned, it will undoubtedly contribute to improved international understanding. As conceived, the program is free of political pressures, having arisen from spontaneous, felt needs among biological scientists.
>
> It is urgent that studies be undertaken to define existing conditions, to understand the mechanisms that control the components of so-called ecosystems, and to comprehend interactions among ecosystems. The International Biological Program places a most welcome emphasis on primary productivity and its meaning for man, on trophic structures, energy flow pathways (food chains), limiting factors, interactions of species, bio-geochemical cycling, species diversity, and other attributes that interact to regulate and control the structure and function of communities.

As much as I enjoy quoting myself, I will refrain from imposing any more reruns of my resonant prose upon the subcommittee. I wish to emphasize, however, that OST's general views of the potential of the IBP are unchanged and the strength of OST's support for U.S. participation in the IBP has not waned during the past year.

Before I comment upon the joint resolution which is the proximate stimulus for this renewed discussed of the IBP, I wish to take the liberty of injecting a personal comment concerning another, but related matter.

As this subcommittee knows well and as several of the members have pointed out on occasion, communication between scientists and Government, especially between scientists and Congress, is often unsatisfactory. There still remain many in the scientific community who, as you put it at the meeting of the National Academy of Sciences last autumn, Mr. Chairman:

> . . . complain of congressional shortsightedness, bias, lack of imagination, and ignorance, and then, when asked for illumination and guidance, decline on grounds that they should not have to spend their time on such matters or that Congress wouldn't understand anyway.

The feeling that many legislative actions reflect a lack of understanding or appreciation of the scientific enterprise is still common. It often, perhaps most often, takes the form of a chronic, low-grade, uncomfortable (but not disabling) resentment which growls along without reaching the intensity required to stimulate its victim to make constructive proposals or to supply the technical information and expert opinion which he assumes to be missing. I cannot offer objective proof, but it is, at least, my clinical impression that the incidence of this disorder is decreasing slowly, although recent strictures on Federal funds for research have tended to impede the rate of its disappearance.

In my opinion, the subcommittee hearings on the IBP published last year and the subsequent report, published in March, constitute some of the most conclusive documentary evidence that now exists of the fallacy of this general notion among scientific workers. The deep interest, the genuine desire to understand, and the sympathetic (but not gullible) willingness to give the scientists every chance to have their say which characterized those hearings are reflected in a remarkably effective fashion in both volumes.

These things having been said, I will turn from generalizations about the IBP to the specific issue at hand, the resolution authorizing appropriation of $5 million to NSF in fiscal year 1969 for the IBP. OST has remained in close touch with the planning activities of the USNC/IBP, now chaired by Dr. Blair, and also with the deliberations of the Interagency Coordinating Committee, chaired by Dr. Carlson of NSF.

I will summarize briefly our view of the current status of the U.S. plans for the IBP.

Planning by the USNC/IBP has been slow, but it has been thorough.

Some of the apparent delay has undoubtedly been organizational. The involvement of many scientists on numerous subcommittees and in large planning conferences has made the enterprise unwieldy and cumbersome, perhaps, but has increased the intellectual input and has generated a wide variety of suggestions and ideas. As the program has evolved, most of the preconceptions with which the task was begun have given way to different and vastly more ambitious and sophisticated notions.

These new concepts, including the analysis of large ecosystems or biomes and the studies of human adaptability, can be characterized as possible precursors of so-called "big" biology in the future. They have been noted and praised by scientists in other participating nations.

The Committee (not, I confess, without urging) has begun to address itself to the problem of establishing priorities. While activities in this area cannot yet be characterized as ruthless, they have become realistic in a very short time.

It is now planned to restructure the Committee so as to subdivide and delegate functions to smaller units and to make it more responsive to the tasks of coordination, communication, and management that lie ahead in phase II of the IBP. Dr. Blair can supply more details concerning the contemplated reorganization, if desired.

Streamlining the Committee, however, will not eliminate the need for additional time to plan. The process of defining and refining the new concepts so as to translate them into integrated action programs rather than a collection of traditional projects is underway, but the task is new, difficult, and far from complete. For example, in the study of the grasslands biome, management arrangements must be devised at all levels of involvement to assure orderly execution of studies, logistic arrangements at the research site, the integration of research and supporting activities, including data collection, data exchange, and systematic analysis of findings in order to guide further studies, to correlate the data collected by many participants in order to reach conclusions about relationships between energy flow, species diversity, vegetational appearance, etc.

The "mission" agencies represented on the ICC already support many programs, both intramural and extramural, which are directly related or can contribute to the objectives of the IMP. Until now, the USNC/IBP has not given systematic consideration to these in formulating programs. The reasons are many: the USNC/IBP has been busy, the demands on USNC/IBP staff have been heavy and continuous, the USNC/IBP combined much of its planning for IBP with measures aimed at gaining equity for disciplines believed to have been neglected, including ecology and systematics. The ongoing programs of agencies concerned with factors affecting human health and welfare seem to have received least attention. This has tended to minimize their potential contributions or to create an image of them as reluctant to cooperate. The membership of the ICC has recently examined the interests of member agencies again, and it is clear that while interest, willingness, and authority to contribute vary from agency to agency, the overall possibilities for participation in and support of the IBP are substantially more than have previously been recognized or acknowledged by USNC/IBP.

Finally, information obtained during the Third General Assembly of the International Biological Program held in Varna, Bulgaria, early last month, indicates that other nations are getting off to relatively slow starts in the development of their respective IBP activities. These include the Soviet Union which established a secretariat for its program only this year. The United States is obviously not lagging behind other nations in this respect.

The annual budget of the international secretariat of the IBP (SCIBP) is about $200,000 and comes from membership dues which range from a minimum of $100 to $10,000 per country. The United States and the United Kingdom are the only two nations paying $10,000. The Russians paid no dues until 1967 when they paid $2,500 as they did again in 1968. Additionally, the United States has been making an annual contribution of $50,000. In short, there is no evidence of any great threat to U.S. prestige because our efforts are lagging behind those of other participating nations or because we are not carrying our share of the international overhead.

It is our conclusion that as important as IPB may eventually prove to be to our national interests, the program has not yet been sufficiently developed to warrant large-scale special funding during fiscal year 1969, particularly in the prevailing fiscal situation.

Even in the absence of needed further planning, the President's fiscal year 1969 budget includes specifically $700,000 for NSF to support U.S. IBP efforts. As mentioned, there is good indication that other aegncies are interested in and may be able to provide support for appropriation types of IBP work during fiscal year 1969. If Congress supports the overall fiscal year 1969 budget submitted for the National Science Foundation, consideration can be given to reprograming to provide additional special funds for IBP activities if these become necessary.

It is not possible to make a prediction at this time as to how the IBP will come out in the fiscal year 1970 budget but, in general, the status of funding for fiscal year 1970 will depend upon:

Progress made by the USNC/IBP and its constituent groups in developing sound, finished, program proposal.

The relative standing of IBP proposals in the overall programs of the agencies having interest in the work that is proposed for IBP; that is, the extent to which IBP activities can be included in ongoing agency programs and supported intramurally and/or extramurally.

The relative standing of IBP proposals for funding by the NSF. We feel, however, that IBP work should be supported to the maximum extent possible by all agencies, including NSF, as a part of their ongoing activities rather than placing major reliance upon separate special funding for IBP in NSF or other agencies.

The overall fiscal situation for fiscal year 1970.

We will continue to follow closely the progress of the IBP. While we cannot give assurances that it will be funded at any particular level during fiscal year 1970, we have taken steps to assure that it will be fully considered. OST has worked with the Bureau of the Budget and NSF in developing the outline for a special study which will lead to a program memorandum on the IBP for submission by NSF to BOB in connection with NSF's fiscal year 1970 budget request. NSF will have responsibility for the study but undoubtedly will be assisted by USNC/IBP and by other agencies, probably through ICC. The special study and program memorandum will deal with the goal and objectives of the program, the progress of USNC/IBP in developing program proposals, the organization and management arrangements for carrying out the proposed studies, the scientific and other benefits that can be expected at alternative levels of funding for the program, the ability of the 10 or more agencies that have an interest in parts of the IBP to participate in and support the program, and the necessity for any special funding that NSF or other agencies feel is warranted for the program.

In summary, Mr. Chairman, for the reasons that I have outlined, OST is opposed to the resolution under consideration by the subcommittee.

I will be glad to answer any questions. Thank you.

Mr. DADDARIO. Dr. Bennett, considering the $10,000 paid by our country and the United Kingdom and the additional contribution of $50,000, do you contemplate this kind of support should continue during this year regardless of the overall fiscal situation in 1970?

Dr. BENNETT. Mr. Chairman, we are talking largely about a matter of timing. If one argues that the urgency for making available large-scale funds in 1969 has anything to do with recognized leadership or prestige or responsibility taken by the United States on the international scene in this program, one finds it very difficult to substantiate this is an urgent problem.

I am perfectly willing to accept the fact that the overall support internationally which amounts to some $200,000 a year is perhaps inadequate. It is my understanding that steps were taken at the meeting in Varna to raise the dues, but I am speaking in terms of the share that the United States pays at the present time, the proportion this represents in terms of total world contribution, and what this means urgently in terms of our possible loss of prestige.

I think that if the National Committee recommends that this shape be increased that there is a very good possibility to do this from the

funds that will be made available this year to the National Committee just as in the past.

Mr. DADDARIO. Following through on the recommendation that the National Committee look very carefully into the way in which the going programs of other agencies can be developed and coordinated, will you go into this just a bit. How will that be helpful in an international sense?

Dr. BENNETT. I will be glad to cite a number of examples. There are certain on-going programs being supported extramurally by some of the agencies that now are part of the on-going program because they were brought to the attention of the committee by the individual investigator who was already being supported and they were adjudged appropriate for the purpose of the IBP.

For a variety of reasons, however, despite invitations to do so, the committee has not yet had time to review all of the many similar programs that are in existence that have not been brought forward spontaneously by investigators who recognize that they might become part of the International Biological Program.

To cite one example, the National Institutes of Health for quite some time has supported a program in arctic environmental physiology at the University of Alaska to the tune of $360,000 a year. This happens not to be included as part of the on-going program simply because it has not come to the attention of the Committee that this program might be a very useful base, for example, for the prosecution of some of the studies on Eskimo peoples. Statements from the responsible individuals in these agencies have indicated not only a willingness but a desire to cooperate, and they have also conveyed the impression that much of the planning that has gone on, as thorough as it has been, was too concentrated in the area of the ecological sciences without recognition of the very great opportunity this program offers for the coordinating of certain other on-going activities.

A number of agencies have indicated that when they receive appropriate proposals they will be glad to suggest to the individuals who make them certain alterations that might make the projects better fit with the objectives of the International Biological Program. Others have indicated, in at least one agency, that if they receive proposals for those portions of the International Biological Program in which they are interested, they would count this as a point in favor in judging proposals submitted spontaneously for support by their agency. All this is evidence, I think, that there remains a great untapped opportunity to get support from the agencies.

Dr. BLAIR. Mr. Chairman, I would like to speak to this because I think Dr. Bennett has been somewhat misinformed.

Our National Committee did approach the Washington agencies and many of them like Agriculture and Interior did provide lists of their on-going research they thought was pertinent to IBP. The particular agency to which Dr. Bennett refers did not give us a list of the on-going research projects they thought were pertinent to IBP. They gave us a list of 15,000 projects, expecting us with our manpower to screen it and it could not be done. It was physically impossible. I think it has now been cleared up this week, the misunderstanding with this particular agency; but they were asked to give us this and they

gave us everything they had and expected us to screen it and this is impossible with our manpower.

Mr. BROWN. Is this NIH you are referring to?

Dr. BLAIR. Yes, sir.

Mr. DADDARIO. That does bear out, however, Dr. Blair, what Dr. Bennett has said, whether it is a misunderstanding or whether it is a lack of staff capability.

Dr. BLAIR. I think this problem has been actually solved.

Mr. DADDARIO. These matters in the final analysis have to be cleared up.

Isn't that correct, Dr. Bennett?

Dr. BENNETT. I would only say, when one realizes the National Institutes of Health is by far the largest supporter of extramural research, the fact it is only one agency, has to be weighed against the proportion of funds that it makes available extramurally as compared to the other agencies; and I am not attaching any blame to anyone. I am simply stating at the present time there has been incomplete exploration of the possibility of cooperation. I am very well aware of the fact that everyone connected with IBP has been quite busy; but in view of this avenue which has been opened up again recently for exploration with evidence that the agencies are willing to cooperate, I simply say that in these times of fiscal stress that we conclude that there really is no substantiated need for large-scale special funding of this program in fiscal 1969.

Mr. DADDARIO. The fiscal restraints are fed in as only one element. You have talked about coordination, the need to look more closely into the agency participation, the interrelation of this activity, and the better recognition of it by the National Committee itself. You also seem to indicate that OST, working with the Bureau of the Budget, NSF, and the other agencies, is putting together a study on this whole proposition. Therefore, your recommendation in 1970 might be different from that which you support at the present time.

Dr. BENNETT. That is quite right, and we have made arrangements, as I mentioned without going into great detail, for NSF to take the responsibility for submission of a program memorandum with its 1970 budget request. This is the way budget requests are submitted; and since NSF is the lead agency, they have been asked to answer a list of questions, some of which involve questions that I have already raised here and indicated have not been fully explored.

Mr. DADDARIO. What you are recommending, Dr. Bennett, is we continue on as we have been, improve the structure of our IBP organization, squeeze out as much support as we can through the agencies, improve the situation generally, and look to the possibility of setting up a special authorization for this, not this year but next. If that is correct, then you are against the resolution presently under consideration by the subcommittee this year, but you might be for it next year.

Is that what I hear?

Dr. BENNETT. The question of special funding for the IBP as opposed to the availability of funds in the agencies as presently categorized that could be applied to these programs is one that will be treated in the program memorandum; and whether the recommendation of the agencies for special funding will be $5 million or whether they will recommend different levels and show what they will be able

to accomplish with or without special funding will be dependent on this study.

But the estimate will be based on objective study and assessment of all the other resources that would be available. I am in no position to know what a recommendation for special funds labeled for IBP might be: but whatever the recommendation is, I am confident it would be backed up by a thorough analysis of other sources available and that it will be considered on the basis of whatever requests NSF makes or any other agency.

Mr. DADDARIO. In the meantime, with the National Committee putting this all together, our effort would consist of IBP-type activities which could be listed as such in each agency covered by ongoing programs.

Dr. BENNETT. Mr. Chairman, to a certain extent that would be true although certain of the integrated programs that have been planned specifically by the committee can be gotten underway and very great effort is being made to analyze these and be sure once they are gotten underway they will be able to continue.

As I mentioned, there is $700,000, provided Congress supports NSF's budget, that will be available that could be applied to this. In the opinion of those who review the proposal, this would be the best way to utilize the IBP funds.

On the other hand, the clear-cut distinction that is being made between new programs and existing programs that are simply grouped together really doesn't exist either because there is one very important project on the study of Latin American Indians as part of the human adaptability program which is being carried on by Dr. Neal at the University of Michigan, which at the time it was offered for the program already had been very well funded by the AEC and was incorporated into the program because it fitted in very well with IBP objectives. This one can be viewed as part of the integrated program, but it actually had its origin as a separate and unrelated project which had been examined by the AEC and which they had already agreed to fund.

My point is that if one examines carefully similar ongoing activities in agencies one might find such projects without having the investigator come forward and offer his work as part of an integrated program of the IBP. There is every reason to believe one could augment in a useful fashion and not just as a showpiece, the achievement of the goals of the IBP. This is an area that has been incompletely explored, and we hope that through the study which well result in a program memorandum this exploration can be carried out in a systematic fashion by the agencies with the help of the U.S. Planning Committee and in a fashion that up until now for a number of reasons—and I don't know which is the more important reason—has not been done to date.

I would be the last to deny that many scientists could use more money than they are getting now; and, as a matter of fact, I would almost say that most scientists I know could use almost any amount of additional money that might be made available now. We are not in a position to accept the argument that a line item for $5 million is urgently needed because it would be the quickest, cleanest, and most convenient method to get this program off the ground at a time when

funds are so difficult to come by in so many areas of scientific research. We would prefer to substitute some study and effort and draw on existing resources at this time.

Mr. BROWN. Mr. Chairman, as I look at these four points that Dr. Bennett has included, I am inclined to feel maybe the fourth point is the one that has established the importance of the first three. It seems to me that the point which you have made such as the progress made by the National Committee and its constituent groups in developing sound, finished program proposals, would tend to be solved with more available resources. If they don't have the resources, you are going to be able to come back next year and make exactly the same point.

For example, this matter of analyzing the NIH very extensive proposals to see which ones would fit into the IBP is strictly a matter of how much manpower or effort you put into it. I am inclined to feel that we need to have that effort put into it in order to establish what you want.

You could make the same case for the other points that you mention. I know that the overall fiscal situation is very poor, but I notice that yesterday the DOD indicated, instead of $2½ billion they were going to need for supplemental $4 billion this month and they are going to get it probably.

That is why we don't have $5 million for this. I frankly think this is a very poor evaluation of priorities personally. I admittedly am biased in this regard, but I would like to ask you if your main point is not really point No. 4 and that if that were different, you would be able to make a case for the $5 million on the ground it would accomplish the things that you cited in points 1, 2, and 3.

Dr. BENNETT. Mr. Brown, I would like to emphasize two things. One has to do with the date at which large scale funding might be necessary, and I will be far less prepared to argue that by the time another fiscal year has gone by, large scale funding might not really be the main thing needed to get this program off the ground; but the evidence that further time will be required in trying to plan for the management of these large-scale programs is very strong. This type of planning where one is really grappling with a completely new idea in a very complex system is not the type of thing that is cured quickly by money, although, of course, money is required in certain of these efforts.

One of the points I am trying to make is that, inevitably, although this committee has been reorganized and made less cumbersome, the concepts they have come up with are such that to simply translate them into an action program that one can put on the road and be sure or reasonably sure that its purpose will be accomplished is posing management questions to which many answers need to be found. This type of thinking requires time.

I would just say it is not possible at present to reach a judgment that the only thing that is needed to really put this show on the road completely is an influx of money. I think one has to differentiate in these austere times between present needs for planning and the probability that at a later time, money may really come to be the crucial issue.

Mr. BROWN. I would like to know if Dr. Blair feels able to respond to this argument in any fashion.

Dr. BLAIR. I can argue—I don't know how we will prove the point—but I would differ with Dr. Bennett in feeling we have solved management problems. Any time you start this kind of research, you are going to have management problems, whether it is this year or next year or 3 years from now. I don't think additional language is what we need. Now we need to get to work.

I would disagree and all I have in the way of hard evidence is the word of people who are competent enough that the National Committee has recognized them as program directors for the integrated programs. These people are accustomed to dealing with research management, and when they tell me they can use this money next year—and I have to to take their word for it—that is the only answer I can give to this. We are ready to put several of these programs into full-scale operation now.

Mr. BROWN. They can't be put into full-scale operation——

Dr. BLAIR. Without money we don't. We plan. Then we have a lag. What I am saying is we are—and I think this is probably the most crucial problem—lack of money to get started. People don't want to lose momentum. They don't just want to plan everything and stop. They want to get to work.

Mr. DADDARIO. Dr. Bennett.

Dr. BENNETT. I want to differentiate between two kinds of management. There is no question but there are people on the committee with experience in research management. But I say there is no person in the world that has had experience in the type of ongoing operational program which is planned for these biomes where one has to manage not only certain logistic problems and the distribution and analysis of data, but one really has to manage and coordinate the activities of anywhere from 50 to 200 scientists who are accustomed to acting individually. It is the management of the program itself and not the general field of research management that is of concern.

The thing that we are looking for, since this will be a trial run, is firm assurance that arrangements can be made to do this, and it is going to take time to make those arrangements. In view of the fact it is going to take time instead of just more money, the urgency for large scale funding in fiscal 1969 in addition to the funds that can be made available from existing sources cannot be justified, in our view, at this time.

Mr. BROWN. If I were to go back and list about 10 programs beginning with a Polaris and Minuteman, couldn't you have said the same thing about the time they were initiated that there was no large-scale previous planning effort comparable to those?

Dr. BENNETT. I am quite certain if I had been questioned on the subject, knowing what I know now, I would have answered that you are correct, there had been no such planning carried out previously.

On the other hand, I am also quite sure that before those full-scale programs were initiated, certain feasibility programs apart from full-time scaled up efforts were mounted. What we are really talking about here is an intermediate stage of feasibility studies that don't involve a total commitment of large resources and manpower without reasonable assurances that foreseeable difficulties have been taken care of. Certainly it will be necessary to modify this program as it goes on, as is true of any large program.

Mr. BROWN. In the Department of Defense a program that is funded at a level of $50 million or less wouldn't have been considered to have gone through a state of several levels of effort. It is only when it gets in the billions that you begin to concern yourself with this kind of planning.

Mr. DADDARIO. Do I understand that to be in the form of a question, Mr. Brown?

Mr. BROWN. I am afraid I am reacting very negatively.

May I say, however, I appreciate very much the constraints under which Dr. Bennett is testifying and this is not intended in any personal way at all.

Mr. DADDARIO. Dr. Bennett, it does appear here that what you are saying is that the National Committee does not have the capability of spending $5 million, but that it could spend something less than that, say, the $700,000 which the National Science Foundation could assign to it in the event the National Science Foundation's budget is fully supported.

Dr. BENNETT. Mr. Chairman, I would put it another way, that the study which we intend to institute would be based on something more than the estimate by the chairmen who have participated actively in the planning of how much money could be used. This is in no way a substitute for their opinions, and it is no assurance that once this program document has been written and these questions I have raised have been answered with the help of the committee and the agencies that the resources can be made available to grant the request.

But we are simply asking for the hard data which might make it possible to put this program on a long-term basis, and I would say that the main argument now has to do with the urgency at this time for large-scale funding in the fiscal year 1969 budget.

Mr. DADDARIO. You support it, as you said, as a worthwhile effort, but rather than agree with Dr. Blair that the year has gone by and therefore we only have four left, you believe it is too early for us as yet to become involved as heavily as we should and it really doesn't make too much difference that we have lost a year or, let's say, two; but that once we study it and then get this whole thing structured, then it can be supported to a greater extent than you believe it ought to be now.

Dr. BENNETT. Mr. Chairman, I will give you a combination of my personal views and the views of the Office of Science and Technology.

Mr. DADDARIO. Will you label them as such?

Dr. BENNETT. The Office of Science and Technology accepts the fact that basic research is a good thing, but I am unable to answer, except when it comes to my own personal research, the extent to which this should be supported.

The interest that this subcommittee has expressed in this program has to do with the results that will be achieved and the way in which they can be applied to a very practical problem. On the other hand, there has been funding for ecological research and ecological studies have been conducted on the basis of individual desire and interest for quite some time. I have no question about the fact that if you believe that basic research is useful, then the amounts of money that have been mentioned here could be employed usefully by ecologists for research.

The question we are raising is how to accomplish the stated objectives of the International Biological Program, not to support ecological research because it may have been neglected or may have not had the status of other areas of biology in the past, not simply to heal all the past ills of certain branches of biology. What we are looking for is the answer to what amount of money will be required to accomplish these IBP purposes most efficiently and what is the most appropriate time to make these funds available—it is as simple as that.

Mr. BROWN. What is your own field of research, Dr. Bennett?

Dr. BENNETT. I am a pathologist, particularly interested in infectious diseases.

Mr. DADDARIO. Dr. Bennett, I understand what you are saying and I don't in any way mean to agree or disagree with you. We are trying to search this out from the standpoint of how best to support a venture which you, Dr. Blair, and others agree is important. It becomes just a matter of how and when to do it; to what extent now and in the future. This is a matter about which men can disagree.

We will now hear from Dr. Haworth and see how he fits into all of this.

Dr. HAWORTH. I, too, have a brief statement I would like to read, Mr. Chairman. Some of it will be redundant in respect to things that have previously been said, but, rather than try to revise it hastily, I will read it as prepared.

STATEMENT OF DR. LELAND J. HAWORTH, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Dr. HAWORTH. The National Science Foundation is proud of its role as "lead agency" for the International Biological Program. When the Office of Science and Technology requested us to accept this responsibility, we were pleased to do so for several reasons. For one, we noted the emphasis on new fundamental research which I underscore in the stated objective of the program: "to understand the biological basis of human welfare." Second, many of the original planners of the program had been our grantees, and we make it our business to respond creatively to research proposals generated by the scientific community. Third, we believed that through an International Biological Program we could help biology to properly enlarge its place among the basic sciences devoted to comprehending man's nature and his place in the natural world. We are well aware that the IBP does not encompass the whole of biology, and could wish its name did not make such a suggestion, but the title has international sanction, and we do not advocate changing it now.

Mr. DADDARIO. What would you call it if you had your way?

Dr. HAWORTH. I have never tried to invent a name, Mr. Chairman, but would favor something more restricted in nature.

If I could be off the record for a moment?

(Off the record.)

Mr. DADDARIO. We can go back on the record.

You don't mean that people who understand what the IBP encompasses are against it simply because its name implies more than it really is intended to support.

Dr. HAWORTH. I don't think so now, but it helped trigger off some opposition originally in my opinion.

Mr. DADDARIO. Is that really well understood now?

Dr. HAWORTH. I think it is pretty well understood.

As the plans for the U.S. contribution to the IBP have developed, we have participated in many conferences, have supported many pilot projects and feasibility studies, and have observed with increasing satisfaction the responsible deliberations of the U.S. National Committee for IBP, appointed by the National Academy of Sciences. We have provided a chairman and an executive secretary to the Interagency Coordinating Committee, set up to channel the Federal Government's support for IBP projects which are of interest to many agencies. We have provided a good deal of concrete financial support for developing programs, as I will explain in more detail in a moment. We have paid close attention to the hearings conducted by the subcommittee on IBP, and we awaited with great interest the findings and recommendations you issued on March 11, 1968. We subscribe wholeheartedly to most of those findings and recommendations, and are as gratified by their tone as by their substance. Quite evidently, the International Biological Program has captured the imaginations of many Congressmen and their staff members, just as it has ours.

Without hesitation, we endorse the International Biological Program and the desire behind House Joint Resolution 1240 to give adequate financial support to it. With respect to the express provisions of the resolution regarding funding, however, we defer to the positions being taken by the Bureau of the Budget and the Office of Science and Technology, with respect to additional specifically identified funds in fiscal year 1969.

Our own budget for fiscal year 1969 as submitted to Congress contains a modest item for IBP. This is the only such line item in the budget of any agency approved for submission by the Bureau of the Budget. However, as Dr. Bennett has said, the Bureau has recently requested us, with a target date in August of this year, to prepare a program memorandum looking toward appropriate funding levels for IBP in fiscal year 1970. According to the guidelines suggested by the Bureau, problems of interagency coordination and funding must be identified and at least tentative resolutions proposed; there is no intention that the Foundation should receive all of any new money recommended for IBP.

I would like to emphasize that according to my understanding of the program memorandum it is to cover a good deal more than matters related merely to NSF's own budget submission. It is part of the budget-making process for the totality of the agencies involved and not simply NSF.

Mr. DADDARIO. I understood Dr. Bennett to say that. He did say he has worked with the Bureau of the Budget and NSF in developing the outline for the program memorandum on IBP, which I understood to be an overall and encompassing one.

Dr. HAWORTH. I wanted to be sure that there was no misunderstanding of one of Dr. Bennett's nonwritten remarks about the program memorandum being part of NSF's budget submission.

Mr. DADDARIO. Dr. Haworth, along this line your thinking coincides with Dr. Bennett's.

Dr. HAWORTH. With respect to the funding. We are in full agreement on the endorsements and so on in the resolution regarding the importance of the IBP that are stated in the resolution but the specifics of the last two sections is what I was referring to.

Through the Interagency Coordinating Committee, the Foundation has already begun detailed consideration of these problems. Dr. Carlson will tell you about some of the recent activities of the Interagency Committee, when he testifies tomorrow. As a result of initial experience with the major integrated programs, we foresee the need for innovative procedures in management that have not been required by biology up to now, at least by this segment of biology. For those that can be handled within the Foundation, new staff appointments or reassignments within the Division of Biological and Medical Sciences will be needed.

Mr. DADDARIO. Doesn't this get us back to Dr. Bennett's point that there needs to be developed the capability of organizing scientists who are able to do basic research on their own into a meaningful structure and administration direction. Isn't this the point you are making, Dr. Bennett?

Dr. BENNETT. Yes, Mr. Chairman.

Dr. HAWORTH. Let me give an example from another field, Mr. Chairman. There are a great many scientists who have experience in basic research in the atmospheric sciences, but in the past they have usually worked alone or in small groups. It is taking a similar sort of managerial effort to organize the worldwide research, known as the Global Atmospheric Research Program or GARP, that will be necessary to prepare for the World Weather Watch. For example, it required considerable management effort to organize the so-called Line Islands experiment last summer in which a lot of different people from several organizations were involved. It will take even more as we proceed to more ramified experiments. This is not in any sense being critical of anyone. It is just a new experience.

Before I outline the Foundation's direct contribution to developing IBP programs, let me place them in context. What I have called "the responsible deliberations of the U.S. National Committee" began rather slowly. There are many kinds of biologists, and it was not easy, either in 1963 when IBP was officially launched or in 1965 when the U.S. National Committee was appointed, to see how they could effectively focus their variegated efforts on anything quite so broad as the biological basis of human welfare. Even now, not all biologists are convinced that it is possible. For a long time, it was assumed by many that IBP could be—or anyway would be—a diverse collection of projects, focused on whatever some biologists would be doing anyway, with the IBP label acquired by virtue of some identifiable but loose "international interest."

Nevertheless, the planning has now proceeded to the point where effective focusing is clearly possible, and some very imaginative programs or subprograms are beginning to emerge. As the British journal Nature remarked editorially—December 2, 1967—

> It now seems that having scrutinized the underlying concepts of IBP more thoroughly than any other community, the United States may now undertake work that is proportionately more significant.

Reference is made, not to the diverse collection of ongoing projects, but to the proposed integrated major programs such as analysis of ecosystems, international study of Eskimos, and aerobiology.

In our fiscal year 1968 budget submission to the Congress we, that is, the National Science Foundation, did not include a line item specifically for the IBP. Nevertheless we are planning to give it significant support from our basic research project budgets for environmental, regulatory, and Antarctic biology, the atmospheric sciences and the social sciences. For three major components of the analysis of ecosystems, as outlined by Dr. Blair, we expect to provide a little more than $1 million in this fiscal year—fiscal year 1968. Part of this includes a substantial contribution to the central program of systems analysis, and part is for the study of grasslands; a little less than half of the million is for the study of tropical rain forest. An additional $700,000 has been granted this year to six major projects closely related to or anticipatory of integrated IBP programs, one of them being in biological oceanography. These include a biological control study of the role and utility of natural enemies in suppressing spider mites in important food crop ecosystems; an ecosystem analysis of the upper reaches of the Altamaha River Basin in the granite outcrops of Georgia; a study of biological implications of weather modification using ecosystem analysis techniques; and investigations of the hydrologic-mineral cycle interactions in small disturbed and man manipulated ecosystems. The project in biological oceanography will be concerned with nutrient limitation and sources of nitrogen for marine primary production. The individual IBP projects, the sort that I have called "ongoing," are to receive another $700,000 from several divisions of the Foundation. Thus it can be truly said that we expect to support a total of nearly $2.5 million for IBP research this year, exclusive of the contribution made last year for this year's operation of the U.S. National Committee.

The new line item of $700,000 for fiscal year 1969 therefore may seem inadequate. Perhaps it is; we expect to receive several more major proposals by December 1968, and it is likely that at least some of these will survive the review process and be ready for funding before the end of the fiscal year. But we are prepared to make every possible effort to support what is clearly supportable from our normal research funds, as our fiscal year 1968 practice demonstrates. We count on support from several other agencies, of course, but the detailed formulas for this support have not been worked out.

To summarize, we are proud of our role as lead agency for IBP. We are impressed by the high quality and innovative challenges presented by the integrated programs developing under the guidance of the U.S. National Committee. We have already made substantial efforts to reprogram our own funds to support such research, and we expect to provide substantially increased support for IBP in the years ahead, in proportion to a new level of concerted effort by many scientists.

Thank you, Mr. Chairman.

Mr. DADDARIO. Dr. Haworth, if we did not have the IBP and you had not listed this as a line item with the figure $700,000, wouldn't you have reached the point where you would have been supporting projects of this kind? Aren't we traveling that road anyway?

Dr. HAWORTH. I am not sure I understand your question. Do you mean——

Mr. DADDARIO. Are you doing this because you are supporting IBP or are you listing it as being IBP support because this is convenient for you to do it? Wouldn't you have undertaken this support in any event?

Dr. HAWORTH. I should have said earlier that Dr. Wilson and Dr. Carlson and Dr. Deevy are here. They may want to add to my comment.

Mr. DADDARIO. We are happy to have them and they can pitch in any time you like.

Dr. HAWORTH. I should have introduced them earlier. I think I would like to make this distinction: Many of what I have called smaller projects undoubtedly would have been supported in any case. Perhaps they would all have; perhaps all of the people would have been supported, though they wouldn't necessarily have done the same thing.

However, the integrated system studies, such as the ecosystems and so forth, wouldn't have even existed without the introduction of the IBP. I think that is a safe statement.

Mr. DADDARIO. Therefore, there is a relationship.

Dr. HAWORTH. That is right and the introduction of a line item itself is a recognition of a special feature that would not otherwise exist.

Now, with respect to the support we are giving, nobody can really devine, of course, just what proposals might have been made, what ones might have been accepted and so forth in the absence of IBP; but I think that the sorts of things I am talking about here—that range all the way from support that is directed at the specific integrated programs that the IBP National Committee has envisioned clear on down to closely related small projects that might have been done anyway—are examples of the sort of thing that Dr. Bennett was talking about; we need to explore and are exploring both internationally and in the interagency committee itself, the extent to which programs supported by the various agencies both intramurally and extramurally can fit into this total program.

I am sure that many scientists will guide their own thinking, their own programs, their own proposals, differently than they would have had they not had this central thread and organized plan that is being developed, and reaching more and more advanced levels. So one important aspect, I think, is that some of what might otherwise have been a shotgun approach by individual scientists is being pulled together in a central plan, even in the thinking of scientists themselves.

Mr. DADDARIO. You put the $7½ million worth of proposals, which Dr. Blair is going to put into the record, in the category where further examination of relationship of these projects with what is already being done. As is necessary, they would be fitted into the study with recommendations in the future as to their acceptability.

Dr. HAWORTH. I have no doubt, Mr. Chairman, some substantial part of these, a significant part, will be funded in part by the line item that has been referred to, but in part with other funds, from NSF and other agencies. What part I don't know. I don't know what the proposals are. I don't personally know the international programs of other agencies or even our own quite well enough to fit it together. But even if I did know what the proposals were, I don't think I should assume that because the line item is only $700,000 the program

will be limited to that amount. The line item this year was zero; yet we funded a great deal.

Mr. DADDARIO. Dr. Bennett, a closer look at these projects which are included in the $7½ million is where you believe additional coordinating activity needs to be accomplished.

Dr. BENNETT. Yes; and as I mentioned last year, it is our view that proposals, no matter where generated, should be reviewed in the agencies that will fund them through the usual review mechanisms. This is precisely what the procedure has been, and thus far these programs have come out reasonably well.

Mr. DADDARIO. How about that, Dr. Blair?

Dr. BLAIR. This is the way we have operated, and my feeling is that we have had very good cooperation from the ICC, the Interagency Coordinating Committee. We worked informally and very closely with them, and I think the system has worked.

As far as review is concerned, we are in our own committee reviewing the proposals, but we are in no way saying we are trying to usurp anybody's right of review. I want to be sure what we want before they go in because we are selling a quality product—we hope. But this is in no way abrogating anybody else's right of review.

Mr. DADDARIO. We should consider the $7½ million worth of proposals as you list them as being ready to begin.

Dr. BLAIR. That is correct.

Mr. DADDARIO. Then you in that regard have no disagreement among ourselves.

Dr. BLAIR. Far less disagreement than might be apparent. I think we are all talking about timing. I have a feeling there is a real possibility of a loss of momentum. This is the thing that worries me. Dr. Bennett doesn't seem to worry quite as much about this probability, but I do think it is real, that people are making plans——

Dr. BENNETT. Mr. Chairman, my worry is about the loss of momentum in the whole scientific community, and it far outweighs my individual worries about the loss of momentum in this particular program. I don't deny the possible loss of momentum, but I think there is a loss of momentum in almost our entire academic research effort which I think may be important, but thus far it has been unavoidable. So I think what is being mentioned for the IBP is part of something that seems to be going on generally, and it is mainly, I think, because of fiscal restraints.

Mr. DADDARIO. You put it in relationship to everything else.

Dr. BENNETT. I should certainly not like the record to show I am not concerned about the possible loss of momentum that may result from the stretching out of any program to be carried out by scientists.

Mr. DADDARIO. I don't understand what you said to indicate that at all, Dr. Bennett.

How about you on momentum, Dr. Haworth? How do you feel since Dr. Blair does have this concern?

Dr. HAWORTH. I don't think I am really competent to judge that, Mr. Chairman. I am not as intimately familiar with this program as I should be. My feeling is that as these things get worked out by cooperation between the National Committee and the Interagency Coordinating Committee and the individual scientists and the individual agencies and so forth, the funding in 1969 applicable to this effort will be larger than seems to meet the eye by what is labeled for

this. Whether it will reach somewhere near $7½ million, I don't know. We aren't aware ourselves or perhaps I should just speak for myself—I am not aware that there are likely to be things that will suffer disastrously or lose a great deal of momentum.

I am speaking here relatively again, as Dr. Bennett has, with respect to the totality of our scientific efforts, and here there is, of course, a question of priorities even within science. But as to any quantitative evaluation of loss of momentum, I wouldn't be able to answer. I think it perhaps could be better stated that the momentum won't increase as much as it might perhaps otherwise have done rather than to predict any actual loss.

Mr. DADDARIO. Then we can assume at this time that OST and NSF believe we ought to continue with our International Biological Program support as we presently are. You both believe that that type of support will allow us to participate and that next year we will receive a report which would give us an indication as to where we would go from there.

Dr. HAWORTH. I think the last question is one for Dr. Bennett to answer.

Dr. BENNETT. Mr. Chairman, I have indicated there will be a study, the result of which will be a program memorandum submitted along with the budget proposal of NSF. I suspect that it will not be possible to make that program document, as such, immediately available to the committee; but I can see no reason, once decisions have been made on it, that the results that have been achieved by the study can't be made available to the committee on request.

Mr. DADDARIO. I understand that. I am not talking about the legal and actual and physical submission of a study to us, but——

Dr. BENNETT. The reason Dr. Haworth had some hesitancy was because of the way you stated your question, I think.

Dr. HAWORTH. Yes. I interpreted it as meaning that——

Dr. BENNETT. He thought you were talking about the document.

Mr. DADDARIO. I am not talking about the document.

Dr. HAWORTH. In the sense that you are now speaking, I now understand what you say.

Mr. DADDARIO. I am not trying to hold you to any fixed date, but to determine what your feelings are. It could very well be we would continue on as we are presently, rather than to do anything as definite as establish an authorization support in the amount of $5 or $6 million.

I understand, Dr. Blair, you would like to have it isolated in an authorization figure?

Dr. BLAIR. I think it would be disastrous to our effort if we continued under the present method of funding IBP. We would have a program like New Zealand which has identified their old research and appropriated no new money; and they don't really have an IBP, although they call it that.

Mr. DADDARIO. Yet, most of the other countries are in fact operating on this same basis. They are getting along and are quite optimistic about what is being done. Your feeling is that it would add prestige to your position and credence to your desire to support such activity.

Dr. BLAIR. I would say in answer to that our program is—and this is not being chauvinistic—on a very different order of magnitude than those emerging from other countries; and I think it is a response in part to the kind of concern your subcommittee has expressed relative to our environment situation. I think these two things have

gotten very closely linked and that our IBP is in part an international effort that is going to contribute to international biology; but I think also it is very much a response to the concern for our own environmental quality in this country.

Mr. DADDARIO. Dr. Blair, I have strong feelings about this. We depend on the advice of all of you. I am extremely anxious to understand what the differences are that exist. We certainly will take all that has been said here today and all that will be said tomorrow into consideration.

I understand Mr. Yeager has two questions.

Mr. YEAGER. Dr. Blair, what commitments do you have for any organizational money from coordinating agencies other than the NSF for 1968 or 1969?

Dr. BLAIR. Actually we have the chairman of the ICC committee here and I think it might be appropriate to ask him.

Mr. YEAGER. You can provide that for the record tomorrow.

If we assume that something like this resolution went through and that the IBP were funded through a line item for the NSF, what would be your view on who would make the final decision as to how that money is eventually spent? Is the National Committee going to do that or would it be an advisory body? Would NSF make the judgment, the Federal Council?

Dr. BLAIR. I think NSF should also speak to this and I can give you my own personal opinion.

Mr. YEAGER. I would like to have a response.

Dr. BLAIR. I think the NSF has been very effective in support of science through the reviews mechanisms they use and I would expect NSF would be able to respond to this by setting up a review mechanism that might be appropriate. It might be very different from the review mechanism they have used in the past; but at the present they are using the ICC and so far as I know this has worked quite well at the present time. But I am speaking only of personal opinion here.

Mr. YEAGER. Do you have anything, Dr. Haworth, you would like to add?

Dr. HAWORTH. I think we will continue to use our "evaluation-by-peers" type of review. Whether at some stage we would have, say, a special review panel for IBP, I don't know. We do, for example, for the Antarctic program. So far we are reviewing IBP proposals through our regular review panels and I believe this has been effective so far. The review panels, of course, are aware, and we keep them up to date, of the developments in IBP. So the interrelationship of these various things is known to them and they are expected to and do consider not only the merits from the standpoint of the whole system of a particular discipline, but also from the standpoint of the relationship to other efforts.

Clearly the opinions of the national committee, the opinions of the interagency committee and so forth, are taken into account in our final judgments. The panels do not, of course, make final decisions. They make recommendations to the staff, and we would expect to do it this way. As I say, whether at some stage this becomes a sufficiently large program so that it should have a special panel, I am not able to foresee at this time.

Mr. YEAGER. Mr. Chairman, I have some additional questions I would like to submit for the record.

Mr. DADDARIO. The record will be supplemented by further questioning. Mr. Mosher.

Mr. MOSHER. No.

Mr. DADDARIO. Mr. Chairman.

Mr. ROUSH. I am very happy to be here and meet these fine gentlemen and see some old friends, and I congratulate you and them on the progress we are making in this field which is highly important.

Mr. DADDARIO. Mr. Chairman, I am pleased to have your statement, but I don't know whether we are making progress. We have a violent disagreement here.

Mr. ROUSH. Out of the disagreement will come, I hope, some resolution.

Mr. DADDARIO. We will adjourn now until tomorrow morning at 10 o'clock at this same place, and to hear Dr. Handler and Dr. Carlson.

We want to thank you, gentlemen, for having been here and we hope we might impose on you further for other questions in the event they become necessary.

RESPONSE TO SUPPLEMENTAL QUESTIONS BY W. F. BLAIR

1. Question: Do you agree that the IBP should perhaps more properly be referred to as the International Ecological Year?

Answer: I believe that it would not be practical or desirable to change the name of the International Biological Program at this stage. The United States is only one of 54 nations participating in the IBP, which has received worldwide publicity under this name. It would be neither diplomatic nor wise to change the name now, even if the prestige of the United States were sufficient to force this change.

In retrospect, a more appropriately descriptive name for the IBP, especially for the relatively sophisticated plans of the U.S. organization would have been desirable. However, it is also pertinent to recognize the fact that the objectives of the IBP have evolved, partly in response to the needs of our times for attention to the very real environmental crisis. It seems to me that the plans are the important thing; not the name.

2. Question: If so, what principal distinction would you draw between ecology and biology?

Answer: Although I would regard as unwise any proposal to change the name of the IBP at this stage, I do believe that it is important to clearly delineate the distinctions between biology and ecology. Biology is the science of living organisms. As such, it can be subdivided in various ways. One way is by "levels of organization," which would involve a sequence of increasing complexity from molecular biology (chemical structure and function of living organisms), through cellular biology or cytology (structure and function of the cells which are another basic unit in the organization of living matter), through histology (structure and function of tissues), through organismal biology (structure and function of whole organisms, including comparative anatomy, comparative physiology), through evolutionary and ecological biology. Evolutionary biology treats populations of organisms as products of adaptation to their environments and ecological biology treats populations or organisms as functional components of a complex system, the ecosystem. Chemical and physical principles are involved in biological science at every level of organization. The methodologies of chemistry predominate in molecular biology. Only at the level of evolutionary and ecological biology does another major component appear. This is the physical environment. Ecology, therefore, goes beyond being solely biological in that parameters of the ecosystem are in part purely physical ones such as character of the substrate, salinity of water, temperature regimes, rainfall amounts and distribution and so on.

The key word that distinguishes ecology is environment. Just as all of biology may be divided along the lines of "levels of organization," so may ecology be divided along similar lines. Ecologists fall generally into three categories:

(1) organismal (sometimes called autecology) or physiological ecology, which emphasizes structural and physiological adaptation of organisms to environment,

(2) population ecology, which emphasizes individual populations in adaptation to environment with respect to behavior, ecological life history, longevity, reproductive rates, replacement, and other demographic features,

(3) systems or ecosystems ecology, which treats whole biomes—biotic component, land, air, water, nutrients, pollutants—as functional systems.

The data from level one contribute to the findings at levels 2 and 3, and the data from levels 1 and 2 are essential to the findings at level 3.

In summation ecology involves biology at the highest and most complex level of organization of life. Virtually all levels of biology contribute to the data of ecology, but ecology goes beyond other biology in that it incorporates features of both physical and biotic environments into its findings.

3. Question: Do you agree with the view that ecology is so undeveloped at this point that it cannot be precisely defined nor ecologists described solely as such? Must ecologists be specialists in other fields of biology who are now working with what is essentially an untried discipline?

Answer: I reject categorically any imputation that "ecology is so undeveloped at this point that it cannot be precisely defined nor ecologists described solely as such." I believe that I have answered this in part in my answer to the preceding question in indicating the main specialties of ecologists. All ecologists certainly do not fit the same mold; nor do all molecular biologists nor all physiologists fit a common mold. I would suspect that there is at least as much community of interest and sharing of disciplinary principles between a physiological ecologist and a systems ecologist as there is between a physiologist studying the photochemistry of photosynthesis in a single-celled alga and one studying the integration of stimuli in the mammalian brain.

Also in answer to this question, there exists a strong and healthy professional society (The Ecological Society of America with about 3,500 members) which publishes two distinguished professional journals (*Ecology* and *Ecological Monographs*) and annually has one of the largest programs of research papers of any professional society that meets regularly with the American Institute of Biological Sciences. These facts all point to the existence of an identity of ecologists and to pride of ecologists in that identity. It is also pertinent to add that ecologists recognize, probably more than most other groups of scientists, the necessity of translating their competence and findings into solutions of the pressing problems of our society. The Ecological Society of America maintains a standing committee (Ecology Study Committee) of top-flight ecologists who regularly review the progress in the field, anticipate future developments, and make recommendations for action. The Ecological Society of America also maintains a Public Affairs Committee, which I presently have the honor of chairing, and which maintains liaison with agencies of the government and with others who require information on ecological matters.

That ecologists know what they are doing and how to do it is attested to by the sophistication of the U.S. program for the IBP. This program has elicited glowing words of praise from our counterparts in such countries as the United Kingdom and Australia.

Finally, the point must be made that ecology does, indeed, have a whole series of principles and generalizations which have been generated by ecological practitioners at the various levels of ecological complexity. At the organismal level there is the principle of environmental *adaptation*, which has high predictive value. For example, a physiological ecologist can predict that a desert mammal will be concentrating its urine as an adaptation to water shortage, or that an arctic mammal will be larger than its temperate-zone relatives and will have shorter ears, legs and tail, thus reducing the ratio of surface area to mass and reducing the extent of heat radiating areas of the appendages. The concept of *competition*, with its many corollary concepts, such as *niche diversity* and *competitive exclusion*, comes from population ecology. *Natural selection* and the corollary concepts of adaptation, and *ecological niche* also belong here. Population control through *negative feedback* is one of the important generalizations from population ecology. At the biome level, the concept of *ecological succession* may be found as far back as Darwin's "Origin of Species," but ecological research developed it into a generalization. The concepts of *nutrient* and *mineral cycling*, of *food webs* and of *pyramids of numbers* are concepts of ecosystem ecology. These examples illustrate the fact that ecologists have generated an impressive set of generalizations for which they need to apologize to no one, whatever his specialty may be.

4. Question: Does the National Committee believe that only ecologists should have a deciding voice in the determination of IBP programs—or are those trained in other biological disciplines competent for this purpose?

Answer: The record of the U.S. National Committee speaks for itself in respect to this question. Although ecologists have predominated at all levels (Table 1),

TABLE 1.—SPECIALTIES OF U.S. SCIENTISTS WHO PLANNED THE U.S. PARTICIPATION IN THE IBP

	Ecologist	System and Evolution	Physiologist	Anthropologist	Mycologist	Soil Science	Entomologist	Aero Science	Conservationist	Geneticist	Geologist	Statistician	Forester	Meteorologist	Agronomist	Microbiologist	Systems analyst	Administrator	Sociologist	Total
Ad hoc U.S. Committee, 1964	6	-----	3	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	11
U.S. subcommittees, 1968	26	16	17	2	4	1	2	3	1	1	1	1	1	1	1	2	2	7	-----	89
U.S. National Committee, 1968	7	2	4	2	-----	-----	-----	-----	-----	1	-----	-----	-----	-----	-----	-----	1	2	-----	19

the U.S. participation in the IBP has been planned by scientists who might be categorized as representing 19 different specialties. This reflects the complexity as well as the breadth and integrative nature of ecological research. Any notion that the ecologists have monopolized the IBP is countered by the evidence that ecologists predominated on the original ad hoc committee but drew into the planning the persons representing the many specialties represented in Table 1.

5. Question: Assuming supplemental funding for fiscal '69 of between $1 and $2 million above what now appears to be available—is it likely that IBP teams ready to go to work would disintegrate? If adequate funding could be assured for fiscal '70, would the organizational damage caused by the delay be serious?

Answer: If $1 and $2 million of new money were made available for FY/69, presently organized IBP teams could be held together and would be ready to go into full-scale action in FY/70. Without such funding, the U.S. contribution to the IBP is in danger of a serious setback.

RESPONSES TO SUPPLEMENTAL QUESTIONS BY IVAN L. BENNETT, JR.

Question 1: On the basis of your knowledge to date, which agencies of the ICC do you believe would be most likely to provide some additional funding for the IBP during fiscal '69?

Answer: NSF has already indicated its intent to support, as far as it is able, the IBP during fiscal year 1969. It is altogether probable that the Atomic Energy Commission and some parts of HEW, Agriculture, and Interior will be both willing and able to fund certain projects that fall clearly within their missions, and that both NASA and ESSA will cooperate in providing facilities and resources for joint endeavors. The clear possibility of substantial cutbacks in Federal expenditures for FY '69 makes it extremely difficult to estimate the seriousness of the problem that agencies will face in funding ongoing research and the extent of their ability to support new initiatives. There is nothing to indicate that allocation of funds to IBP projects will be disproportionately limited by fiscal strictures, provided, of course, that IBP project and program proposals are of a scientific quality and relevance sufficient to make them competitive for limited resources.

Question 2: Do you believe that the narrow view of old line mission-oriented agencies with regard to how their funds must be spent tends to work against the funding of the IBP under current arrangements?

Answer: Both allocations within the Executive Branch and appropriations by Congress are justified on the basis of the legislative authorities which define the responsibility and mission of an agency. The "narrow view of the old-line mission-oriented agencies" mentioned in the question is externally imposed more than internally generated. Because this check and balance mechanism is intended to assure the relevance of agency expenditures to agency mission, it tends to work against the funding of any new enterprise such as the IBP until coincidence of agency objectives and goals of the new program can be established. The proposed interagency review and program document are intended to clarify the relevance of the IBP to mission objectives.

Question 3: Would it be helpful if Congress provided a resolution authorizing agencies of the ICC to transfer funds for this purpose? In other words, would such congressional action ease the minds of the agency administrators on this point?

Answer: In general, yes. Especially for relatively small amounts which could be assembled in any one department or agency by contributions or reprogramming of funds from the separate bureaus or offices. To the extent that IBP objectives coincide with broad department missions rather than with separate, narrower bureau missions, this mechanism would be particularly helpful.

Question 4: How do you view the relationship between the National Committee and the ICC insofar as powers of decision are concerned with regard to IBP program content?

Answer: The National Committee has had free rein in developing the conceptual framework for the IBP program. The Federal agencies represented on the ICC will have to assume the responsibility for final selection of specific programs to which they will contribute funds. The National Committee has said what needs to be done, and in general, how it can be done. The ICC role is to satisfy itself that the goals are suitable and, especially, that the proposed programs are reasonably certain of achieving the goals.

Question 5: Should conflict arise because of the foregoing, how do you believe they would be resolved?

Answer: As you know, the Bureau of the Budget has requested a program memorandum on IBP from NSF. The information obtained should be very helpful to both OST and BOB as a blueprint for further action. NSF has principal operational responsibility for IBP and undoubtedly will play a key role in resolving day to day issues as they arise. IBP is a product of the biological sciences community and must remain responsive to all of the elements of that community, both Federal and non-federal. With this philosophy, I do not foresee any serious conflicts among the various organizations that have a role in directing and developing the program.

RESPONSES TO SUPPLEMENTAL QUESTIONS BY LELAND J. HAWORTH

Question 1: How much money is now going into ecological research, governmentwide? (Best estimate) How much is NSF putting in? How much does NSF grant for ecology as compared to other forms of biology? To physics? To math? To chemistry?

Answer: It is not possible to give a full and accurate answer, because no survey of Federal support for ecology has ever been made. Any such survey, if initiated, would immediately encounter the almost unanswerable question, "What is ecology?" and replies to that question by a variety of Federal agencies might be very difficult to summarize or evaluate. To see why this is so, one could notice that "oceanography" and "urban studies" are certainly not all ecology, but each field includes a significant portion that is ecology. The NSF does not have a program called *ecology*, but the program in Environmental Biology covers much (but not all) of what is called ecology by professional ecologists.

Dr. Deevey discussed this question in his statement to the Subcommittee on March 12. He gave figures indicating that whereas NSF's Environmental Biology Program allocated about $6 million in 1967 and $6.5 million in 1968, a survey made by ecologists in 1966 showed that at least $9 million (possibly as much as $20 million), more had been allocated to ecological research by about a hundred agencies, Federal, State, and private. Dollar amounts were available for only about 40 per cent of the projects recognized by that survey, the known dollar total (including some from NSF) being $12.4 million as of December 1966.

Rounding such figures, one might guess that basic research in ecology supported by all Federal agencies amounts to $20 to $30 million annually. When asked somewhat different questions in government surveys, however, the agencies themselves tend to identify much larger sums. Naturally, such sums include a great deal of applied research, pursuant to agency missions. For example, "Advancing scientific understanding of natural communities," a report prepared for OST and BOB and currently being circulated to agencies for comment, certainly deals with ecology, as its preamble says. According to this survey, Federal activities in this ecological area (i.e. "wildlands") amounted to $162 million in 1965 and $175 million in 1966. Research "and related activities" (including taxonomy and "other support") accounted for about three-quarters of these totals, the remainder being mainly "surveys."

"Pollution research" is also very largely ecological research, of course, though nearly all of it is applied ecology. As you know, a report on this subject to the FCST Committee on Environmental Quality has recently been released by OST. Including pesticide research which was tabulated only for 1967, the total federal effort in pollution research was estimated at $211 million in 1967 and $250 million in 1968. NSF's own contribution to this effort, a modest $4 million in 1968, was correctly identified by the Committee as "contributing to the understanding of" pollution but "not conducted for pollution-related purposes" and was part of additional amounts totalling about $135 million annually that were *excluded* from the above totals. As research on "aircraft noise" was another part of the excluded $135 million, but is ecological in some sense, one sees why a really satisfactory answer to your question is probably unattainable. If noise is called an ecological problem, psychic stress from other environmental causes can be also.

Returning to NSF's contribution and the comparative amounts allocated to basic research in some other sciences, the $6.5 milllion allocated to Environmental Biology in 1968 is certainly a minimal estimate of the total for ecology. Systematic Biology (i.e. taxonomy, correctly regarded as "supporting" ecology) received another $5.3 million, and some portion of support to Facilities and Spe-

cial Programs is related to Environmental or Systematic Biology or both. Within the (otherwise nonbiological) Division of Environmental Sciences, a substantial part of Antarctic Biology, and some aspects of Earth and Atmospheric Sciences and Oceanography, could be called ecology. Of the total $57.3 allocated to the Division of Biological and Medical Sciences in 1968, the minimal (Environmental Biology) share represented 11.3 percent.

One way to compare these amounts with those for physics, mathematics, and chemistry is to refer to the attached table of obligations, "NSF support of (research in) science by major scientific areas," which was part (page 3) of the fiscal year 1969 budget request as submitted to Congress. Looking at 1968 estimates, one sees that "Biology" at $44.3 million is not congruent with the Division of Biological and Medical Sciences, listed above at $57.3 million. The major reason for the difference is that biological oceanography, much but not all of which is ecology, is listed under Oceanography. Other "major scientific areas" would also need qualification in comparing these categories. For instance, physics and chemistry as subjects extend through Astronomy, Atmospheric and Earth Sciences, and Engineering, and some of the "Social Sciences," in particular physiological psychology or, psychobiology are also biology.

Much of the Foundation's support for ecology, of course, is not for direct research support, but is channeled into fellowships, traineeships, institutional equipment and facilities grants, educational conferences, teacher-training grants, and so on. All such support would be additional to that shown in the attached table. Unfortunately for the purpose of this memorandum, ecology is not explicitly recognized as an area for support in our educational and institutional relations divisions, and it is not possible to estimate its total in dollars.

Question 2: The NSF budget for 1969 carried an IBP line item of something like $700,000. How many projects under this item—and which ones—would not have been funded except for the IBP?

Answer: The 1969 budget has not been approved by Congress, and until its total amount is known we do not guarantee to "protect" the line item for IBP at the requested level of $700,000. I presume your question is really directed at fiscal year 1968 funding. We expect to receive proposals for components of IBP integrated major programs, early in fiscal year 1969, with requested amounts substantially in excess of $700,000; indeed, several are already in and are undergoing review. We can promise only to fund approved proposals to the limit of our capability, while exploring (through the Interagency Coordinating Committee) every possibility of joint funding with other agencies.

As evidence that this capability is not negligible, we point to our practice in 1968, a year for which no line item was initially approved for IBP. The $700,000 allocated to the BMS Division was identified but was not "new money" for IBP in 1968 when the budget for 1969 was submitted. As indicated in my statement on May 1, not $700,000, but a little more than $1 million, was granted to three major IBP projects: the central Analysis of Ecosystems planning program, the prototypic grassland project, and the tropical forest project in Costa Rica. These three, then would not have been funded had IBP major programs not reached this stage during 1968.

Of the additional $1.5 million granted in 1968, about half went to six smaller IBP projects, which however are anticipatory of major integrated programs that hope to expand in 1969. The other half, or $700,000, was for IBP-related but not major projects, the sort that are now being described in other agencies as "ongoing." To us, of course, they are not ongoing, being in fact new projects; the essential point here is that they are "the sort of project we (presumably) would have been supporting anyway, even if IBP did not exist." In 1966, or 1967, such projects were seen as constituting IBP: now, because of their miscellaneous character, they take a subordinate position, though every one of them is high-grade science and we are not at all ashamed of them.

If the 1969 budget is significantly reduced below the requested amount, we can hardly expect to expand our support for IBP; the most we can hope to do is to maintain it at the 1968 level.

Question 3: What is the sentiment within NSF for pushing the IBP?

Answer: Sentiment with NSF for pushing IBP ranges from cautious optimism to strong advocacy. Enthusiasm is naturally highest in Environmental Biology, which regards the "environmental management" components of IBP with some paternal and much professional pride. But the national importance of upgrading

ecology is well understood at all levels in the Foundation, including the National Science Board.

Question 4: Would NSF, if provided the money, be willing to set up a National Center for Ecological Research?

Answer: The "national institute of ecology" concept is being actively discussed by the NSF staff and its advisory committees, and in various forms has attracted much interest and some support. We are not quite ready to receive, let alone fund, a formal proposal to "set up" such an institute, but it is conceivable that some version of the idea may find expression in budget submissions within the next couple of years. At this stage we hesitate to adopt your phraseology—i.e. a "National Center"—because a major question, "one center or several," is still at issue. We find it particularly interesting that you should raise this question in the context of IBP planning, for a national institute for ecological research would certainly be a possible mechanism for maintaining "IBP-type programs" of the sort now emerging. Research, however, is not the only function such an institute might perform; data storage and instrument development are others, and presumably the Congress would be most interested in public-information and consultative functions. How best to provide for all these functions is the subject of active discussion in the Foundation and the Ecological Society of America.

Question 5: Would NSF be willing to handle the funding of the IBP in the same way it did the IGY? If not, why not?

Answer: Though similar in some respects, IGY and IBP are quite different in others, and we would not want to handle the funding in the same way. IGY was a short-term operation, and geophysics does not ramify into as many kinds of science or into so many mission-oriented agencies as does environmental biology or ecology. The managerial problems confronting IBP are proportionately much more formidable. For IGY, the NAS/NRC set up a managerial staff of several dozen professionals—in short, an "ad hoc institute"—that coordinated but did not program the activities of the (mainly academic) scientists. Much good science was done, but the administration was not always efficient. Frankly, we recoil from the idea of managing IBP in that way.

Now, after much more experience with national programs and large scientific ventures, we are convinced that NSF's own staff has or should have the capability to manage those major IBP programs for which NSF takes lead-agency and funding responsibility. Such capability as may now be lacking we intend to develop with appropriate speed. For example, a position for an IBP scientist-coordinator has already been added to the Section of Environmental and Systematic Biology, and plans for reorganizing and expanding the Section are under way.

Question 6: If the IBP were handled through NSF on some other basis than the IGY method—what would the role and influence of the National Committee be? Would NSF be in a position to override the Committee's decisions and plans?

Answer: It follows from our answer to question five that we see the role of the USNC as one of scientific guidance and program design, but not of program management. The latter role should be played by the Federal agencies that provide the funds, and cannot be delegated without risking loss of fiscal control. The vital scientific influence of the USNC, its advisory committees, and its program directors, would not be diminished in any way by this division of responsibilty, as we see it.

The scientists involved are mainly from universities, and the leaders will be serving IBP part-time without compensation, as an extension of their normal research activities. As "research directors," i.e. as principal investigators on many ordinary research grants, they have perhaps grown accustomed to "project administration," but they have shared fiscal responsibility with the business officers of their universities and with NSF's (or NIH's, etc.) fiscal offices. Probably few of them are aware of the magnitude of the latter service to them as scientists.

Usually, then, when academic scientists speak of "administration" or "management" they really mean "program design," at which they are unsurpassed experts, but what the granting agency provides in the form of "program management" they often regard as annoying or irrelevant in detail. Thus there is a semantic problem about "management," perhaps intrinsic to the "project-grant system"

as applied to basic research, that may not arise in a Federal "in-house" scientific program. Once this is understood, we beileve the relation between the USNC and (say) NSF can be seen as an extension of the familiar relation between the principal investigator and NSF under the project-grant system.

Although this relation is an extension of a familiar system, it cannot be extended to anything so complex as an IBP major integrated program without careful attention to what we call management. What is involved is not only "big biology" i.e. teamwork and programmed research of a sort that has not existed before it; it extends biology and the work of biologists into geophysics and systems engineering, as scientific disciplines, and overlaps the mission-oriented research of several government agencies—such as ESSA—that are unaccustomed to biology in any form. Hence IBP is much like the Global Atmospheric Research Program (GARP) but more complex and difficult to manage.

For these reasons we view IBP, especially its U.S. component, with a mixture of admiration and apprehension: admiration for the bold, imaginative program design that promises to make part of ecology into "big science," plus apprehension lest the fiscal and administrative complexities of truly multidisciplinary research by many people, many universities, and many agencies defeat the objectives of the program. We do not believe that any one or a dozen university scientists, or the NAS/NRC structure as a whole, have the managerial capability that is required. On the other hand, we find the managerial problems so interesting and innovative that the management itself becomes an intellectual and scientific challenge to the Foundation.

In summary, in our view, the USNC is a corporate body of university scientists acting as principal investigators, who have designed an outstanding interesting and innovative program, and the NSF should provide or arrange for the program management. Because the staff controls the amount and flow of funds, some staff contribution to the program design would be perfectly normal. Such normal "shaping" and "trimming" should not be seen as "overriding" the Committee's decisions and plans.

Question 7. How might conflicts of this nature be resolved?

Answer: "Conflicts" of viewpoint between NSF and its grantees are not unusual, and have almost always been resolved amicably. One reason may be that a certain proportion of NSF's scientific staff are academic scientists on temporary duty as program managers, and understand the problems of their academic colleagues from their own first-hand experience. In the final analysis, of course, irreconcilable conflicts must be resolved in favor of the agency that awards and administers the funds for scientific research. No other policy is consistent with our responsibilities as Federal employees.

NSF SUPPORT OF SCIENCE BY MAJOR SCIENTIFIC AREA, OBLIGATIONS

Page		Actual, fiscal year 1967	Estimate, fiscal year 1968	Estimate, fiscal year 1969	Increase (+) or decrease (−) fiscal year 1969–68
16	Astronomy	$19,091,678	$24,989,000	$25,000,000	+$11,000
52	Atmospheric sciences	25,805,352	24,865,000	26,900,000	+2,035,000
83	Biology	44,395,411	44,300,000	46,600,000	+2,300,000
91	Chemistry	20,327,162	22,300,000	24,200,000	+1,900,000
99	Earth sciences	9,839,550	9,700,000	11,400,000	+1,700,000
106	Engineering	20,187,841	20,700,000	21,800,000	+1,100,000
114	Mathematics	13,053,370	13,100,000	14,500,000	+1,400,000
120	Oceanography	23,230,715	31,800,000	32,500,000	+700,000
129	Physics	29,466,603	28,900,000	33,700,000	+4,800,000
141	Social sciences	14,724,432	16,000,000	18,800,000	+2,800,000
	Subtotal	220,932,114	236,654,000	255,400,000	+18,746,000
	Less reimbursable	−65,221	−165,000	−600,000	−435,000
	Total	220,866,893	236,489,000	254,800,000	+18,311,000

The meeting stands adjourned.

(Whereupon, at 12:30 p.m., the subcommittee adjourned to reconvene at 10 a.m., Thursday, May 2, 1968.)

INTERNATIONAL BIOLOGICAL PROGRAM

THURSDAY, MAY 2, 1968

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10:20 a.m., in room 2325, Rayburn House Office Building, the Hon. Emilio Q. Daddario (chairman of the subcommittee) presiding.

Mr. DADDARIO. This meeting will come to order.

Our witnesses this morning are Dr. Philip Handler who is the chairman of the National Science Board and the chairman of the Department of Biochemistry at Duke University Medical School, and Dr. Harve J. Carlson, chairman of the Interagency Coordinating Committee for the International Biological Program and director of the Division of Biological and Medical Sciences of the National Science Foundation.

We are, of course, happy to have both of you gentlemen here. I would like to have you both come to the table at the same time.

Before proceeding, I again apologize for holding this meeting up a bit, but I was asked to substitute for a Member of our Congress in a television program because he was ill. I would also like to turn this meeting over to Congressman Lukens for a moment or two now.

Mr. LUKENS. We don't mind waiting at all for quality to arrive.

I would like to read into the record that the committee has the privilege of having four high school students from my district visiting us to find out how Congress works. They are part of a formal work-visitation program. They are Mr. Steve Cole of Middletown, Tom Harrison of Middletown, Sandy Burgess of Lebanon, and Linda Dooley of Hamilton. I wonder if the four will be kind enough to stand?

Mr. DADDARIO. We are happy to have you here and happy Congressman Lukens was thoughtful enough to invite you. I think if you will bear with us a bit you might find these meetings quite interesting.

Mr. LUKENS. I would like to note that it is obvious we have one of the best looking districts in Ohio.

Mr. DADDARIO. That is enough of that, Mr. Lukens.

Dr. Handler.

Dr. HANDLER. I think it might serve your purposes best if Dr. Carlson went before me, if this is all right with you.

Dr. CARLSON. May I have your permission for Dr. Edward Deevey to sit up at the front table?

Mr. DADDARIO. Certainly.

Dr. CARLSON. He is my right-hand man. Not only does he know the background of the Foundation program but also of the Interagency Committee. He is on leave from Yale University as what we call a rotating program director and section head, and I am very happy to have him up here with me.

Mr. DADDARIO. We are happy any time you reach into Connecticut for talent.

Dr. HANDLER. Then they want to go home.

STATEMENT OF DR. HARVE J. CARLSON, CHAIRMAN, INTERAGENCY COORDINATING COMMITTEE FOR THE INTERNATIONAL BIOLOGICAL PROGRAM

Dr. CARLSON. Today, I am representing the Interagency Coordinating Committee for the International Biological Program. It is a pleasure to appear before this committee again in order to bring you up to date on the activities of the ICC–IBP since I last reported to you on May 9, 1967.

At that time, plans for the US–IBP efforts were beginning to jell, but no proposals for the large, integrated research programs had as yet emerged. In the past year, however, several of these programs have been prepared for submission to Federal agencies for funding. Under the aegis of the Human Adaptability Subcommittee of the U.S. National Committee for IBP, two major programs were developed. These are the Migrant Peoples program, which deals with the adapting mechanisms of a group of people who have migrated from Holmes County, Miss., to Chicago, and the International Studies of Eskimos program, which is concerned with adaptations of a human population to the stressful environment of the Arctic. The last of these has obtained Air Force suport for its initial stages and additional funds are being requested from the National Institutes of Health. The Office of Naval Research has also promised logistic support at its Point Barrow, Alaska, station for the study of these circumpolar peoples. A request for support for the Migrant Peoples program is currently under consideration by the National Institutes of Health. The Office of Economic Opportunity has also voiced an interest in this activity.

Perhaps the greatest development to date is the emergence of a detailed proposal for the ecosystem analysis program which will serve as the central focus for the US–IBP effort. The aim of this investigation is to increase our understanding of the interaction of a biological community with the nonliving factors of its environment. This proposal consists of four components. In the first of these Dr. Frederick Smith, program director for the ecosystem analysis program, requests support for continued activity in the search for basic principles and common characteristics among ecosystems, and for the development of the total ecosystem analysis program for the six biomes chosen for study. The second component requests funds for the initiation of the research program on a grassland, the first of the biomes selected for ecosystems analysis, to be conducted under the direction of Dr. George M. Van Dyne, Colorado State University. The third portion for which support is being sought consists of four separate activities: Development and refinement of systems techniques for ecosystem modeling,

data analysis, information system design, and improvement of research management techniques. The expertise on environmental problems and systems analysis of the Travelers Research Center is to be called upon for the execution of this section. Last is a proposal for a feasibility study of the use of multispectral sensing techniques in ecosystem analysis.

Dr. Smith's proposal is receiving favorable consideration in the Foundation, and support will be forthcoming in fiscal year 1968 for this component of the ecosystem analysis program.

The ICC–IBP responded favorably to the overall aims of the grassland biome program, but expressed concern that some details on research and management were not completely developed. Limited funding was recommend which would admittedly result in a reduction in scale in the early stages of the program, but would have the beneficial effect of providing the opportunity for strengthening the research program and its management. Of the $700,000 approved by ICC–IBP for the first 15-month period, the Foundation is presently considering a contribution of $350,000 with fiscal year 1968 funds. It is hoped that the remaining half will be provided through contributions from other agencies in fiscal year 1969.

Mr. DADDARIO. Dr. Carlson, without going into the details of these programs which fall somewhat under the analysis of ecosystem which we included in our report and which was one of the best prepared of the programs under consideration, let's get into funding. It appears that you are in favor, at least insofar as this program is concerned, of having it funded as an ongoing program within some of the agencies and with some help from the National Science Foundation.

Dr. CARLSON. Yes, sir.

Mr. DADDARIO. And that you consider this proper support to the International Biological Program and that you do not necessarily believe there ought to be set aside a figure where the funds are authorized specifically for those programs which fall under the aegis of IBP.

Dr. CARLSON. I will bring out later in my testimony, sir, that we know there are a number of major types of programs or proposals being prepared to study biomes such as the tundra, the deciduous and coniferous forests, et cetera, which will require additional funds.

Now, the total funds available at the present time within the Foundation and within the Biological and Medical Sciences Division and specifically in the environmental programs, would not be such, no, sir, to take care of all of these if they should be submitted to the Foundation or to the Interagency Coordinating Committee prior to the beginning of fiscal year 1969.

Mr. DADDARIO. With that limitation of biomes chosen for study, you mention a few of them which need to be looked into further.

Dr. CARLSON. Yes, sir.

Mr. DADDARIO. The ones you have mentioned in a sense cut down that list of six to two or three.

Dr. CARLSON. That would be right; yes, sir.

Mr. DADDARIO. Why don't we keep going? We can get back to the point where we get into the effect that this manner of funding will have.

Dr. CARLSON. Funding of the Travelers Research Center component is also under consideration. Finally, support may become available through agencies represented on ICC–IBP for the multispectral sensing feasibility study.

Continued evidence of support of the IBP by the Federal agencies can be demonstrated by their participation in the activities of the U.S. National Committee for the IBP of the National Academy of Sciences. Contributions for fiscal year 1968 support of the USNC, approved at the level of $385,200, were made by 11 components of eight Federal agencies. Funding of U.S.N.C. activities has been approved for fiscal year 1969 at a somewhat reduced rate reflecting the somewhat reduced efforts of the USNC now that the planning phase for the US–IBP is nearing completion and the USNC–IBP enters its operational phase. There are indications that multiple-agency contributions will be forthcoming for the fiscal year 1969 period.

Further interest in IBP was demonstrated by a number of agencies of ICC–IBP in response to my request for comments on House Joint Resolution 1240.

The Department of Health, Education, and Welfare has stated that the subject areas of IBP of greatest interest to that agency are those concerned with human adaptability and environmental physiology. Currently the Department has before it proposals for two major integrated programs—Migrant Peoples and International Studies of Eskimos—which fall in those general areas.

A major contribution is being made by the Agricultural Research Service of the Department of Agriculture by provision of the site for the grassland biome program, the Central Plains Experimental Range at Nunn, Colo. ARS scientists will also be involved in coordinating and facilitating IBP activities at the site as well as participating in some of the research projects. The Forest Service of that same Department has stated that its mission could be advanced through IBP programs especially when they are concerned with forest or range ecosystems.

As I mentioned earlier, a major contribution is being made by the Department of Defense through the Air Force Office of Scientific Research by its support of the International Studies of Eskimos program.

I could go through the whole membership list for ICC–IBP, and show, by similar comments, the concern of each of the agencies for the success of the US–IBP efforts, but I will not take the time to do so now. If you should wish a summary of such comments, I shall see that it is provided.

Mr. DADDARIO. It would be very helpful if you would, please, Dr. Carlson.

Dr. CARLSON. Yes, sir.

By the submission of House Joint Resolution 1240, you and your committee demonstrate your understanding that the aims of IBP cannot be met simply by reprograming on-going research or by reassigning staff to participate in certain phases of the program. The major, integrated programs, the largest and most costly of which is the ecosystem analysis program with its six separate biome studies, cannot be successful unless additional funds are forthcoming.

If you were to ask me today what is my evaluation of the cost for the US–IBP effort, I could only give you the roughest estimate. Dr.

Haworth informed the committee yesterday that the Foundation is being asked by the Bureau of the Budget to prepare a program memorandum on IBP. Sometime this month we shall prepare an initial response, and, hopefully, by August a fairly firm financial assessment can be made. It is obvious that we shall have to call upon the IBP staff of the academy, the USNC–IBP, and the ICC–IBP in preparing the memorandum.

The program memorandum will "* * * identify the issues and alternatives and * * * identify benefits likely to result from alternative IBP program content, timing, and level of funding." It is not the intent of the Bureau of the Budget to place full responsibility for IBP funding on the National Science Foundation. It rather seeks to develop greater involvement of a number of Federal agencies in the support of IBP programs. The BOB prospectus for the program memorandum states that of the six to 12 major integrated programs now being developed by the USNC–IBU:

> Some are related to the missions of several agencies. Others appear to be primarily within the interest and funding authority of a single agency—so that one agency would quite clearly have lead responsibility for support and program management.

Mr. DADDARIO. That, Dr. Carlson, seems to me to be an assumption that the Bureau of the Budget is making before a study is submitted to it.

Dr. CARLSON. These are their prospectus and guidelines to the National Science Foundation and I am just quoting from them, and I would have to agree with you, sir.

Mr. DADDARIO. We do understand, so the record may be clear that the National Science Foundation, which is playing an important role here, is not necessarily the lead agency because it is participating in the preparation of this study but that other agencies must necessarily be included.

Dr. CARLSON. Yes, sir; and through my role as chairman of the Interagency Coordinating Committee, I would hope that we could have the agency representatives much involved in the preparation of their parst of this program memorandum which would be combined into an overall program memorandum for the Bureau of the Budget. At least this is the way I see it at the present time.

Mr. LUKENS. If you don't mind me interrupting, Mr. Chairman, do you feel, Dr. Carlson, right now, without putting you on the spot, that the agency which has inherited a natural lead and should perhaps take this responsibility is the NSF?

Dr. CARLSON. Yes, sir. That is my personal opinion; yes, sir.

Mr. LUKENS. I had never seen this clearly stated and I just wondered.

Dr. CARLSON. The statement—and I don't have the letter with me—but Dr. Hornig did ask Dr. Haworth to set up a coordinating-type committee, and I was asked to take this responsibility over by Dr. Haworth. So we would more or less be the lead agency. I think this is the way you look at the Interagency Coordinating Committee.

The separate components of the ecosystem analysis program and one or two other large programs such as aerobiology will require special funding. Other programs, although carrying budgets somewhat larger than most individual projects, can, we think, be handled through regular proposal review and funding mechanisms of the Federal agencies.

If special funds become available to the NSF they are not likely, in view of budgetary restrictions, to be of a magnitude to fund all of IBP. These special funds should be used primarily to supplement the support of those phases of the ecosystem analysis programs and any other large programs whose budgetary requirements exceed the funding ability of granting agencies.

We are in frequent contact with the USNC–IBP and are aware of the state of development of proposals for the major integrated programs. We anticipate that a number of these will be ready for submission, as I pointed out a while ago, to the granting agencies in December 1968 or early January of the succeeding calendar year. Review by the ICC–IBP, and normal processing by the Federal agencies should ready these proposals, if approved, for funding in fiscal year 1969, although budgetary restrictions may force us to carry over some of these into fiscal year 1970 and beyond.

As reported by Dr. Haworth in yesterday's testimony, the Foundation will fund in fiscal year 1968 three proposals relating directly to the ecosystem analysis program in the amount of $1,024,400. Five proposals having direct relevance to the ecosystem analysis program which may be identified as a part of the comprehensive portion of that program have been financed at the level of $624,500. One other grant funded at $79,800 describes an investigation which is anticipatory of a major program to be developed by the Marine Productivity Subcommittee of the USNC–IBP. Lastly, 21 individual projects are to receive support at the level of $717,600. Details of these proposals were provided in Dr. Haworth's testimony. Thus, the total support provided for IBP exceeded by $1,746,300 the $700,000 allowed in the Foundation budget for this item. The additional funds have come from basic research allocations of several offices in the Foundation.

It appears obvious that the $700,000 in the President's budget for fiscal year 1969 will again require supplementation through the use of basic research funds. The large number of costly proposals for the integrated research programs anticipated in fiscal years 1969 and 1970 are likely to exceed our ability to support by several magnitudes. To continue to shift large amounts of money from basic research budgets would be detrimental to our existing research support programs. Members of the ICC–IBP have also stated that their current budget levels will not permit them to undertake, except in a limited way, the support of the large programs which comprise the major thrust of the US–IBP.

In spite of our demonstrated need for additional funds in fiscal year 1969, the suggestions for funding in House Joint Resolution 1240 present problems to which the member agencies of ICC–IBP cannot address themselves directly. It would appear that the Bureau of the Budget must be called upon to deal with the matter of the use of contingency funds or an additional appropriation for the fiscal year 1969 budget.

I hope that my comments have demonstrated that the Foundation and other members of the ICC–IBP, have given much consideration to the problems of support of the IBP, and are making every effort, given existing budgetary restrictions, to help launch a successful US–IBP effort in fiscal year 1969 and succeeding years.

Mr. Chairman, I will be glad to answer any questions which you might have.

Mr. DADDARIO. Before we get into any questions, because I do think that we are here to discuss just one aspect of this which is how it ought to be funded, who controls it, and whether it ought to be separate, I think we ought to hear from Dr. Handler.

STATEMENT OF DR. PHILIP HANDLER, CHAIRMAN, NATIONAL SCIENCE BOARD

Dr. HANDLER. Thank you, Mr. Chairman. It is a privilege for me to appear before you this morning. Unfortunately, I am not as knowledgeable as I might be with respect to either the programs of IBP or ecology itself. Most of what I know about ecology I have learned by reading the writings of Dr. Deevey in recent months.

In the early days of the planning for the IBP, I was among those experimental biologists who viewed the IBP with something less than enthusiasm. I am afraid that attitude was shared at the time by some of my colleagues of the National Science Board. With the passage of time, as these programs have sharpened and the goals have been more clearly delineated, I think both my enthusiasm and that of my colleagues of the Board have risen very considerably, until now I am quite certain that all of us are generally enthusiastic about the programs, its goals, and its hope for the future.

We remain, I think, somewhat uncertain as to whether or not the program in its present format will achieve the actual objectives to which you look forward. The most impressive document I have yet encountered in my reading about the program is the report of this committee. I learned more about the program by reading this report than any of the other documents I have yet encountered.

The goals of the program are set forth very clearly, and the aspirations for the country are made quite plain. I am not entirely certain in my own mind that even now the program can achieve those goals. I am not certain that one day they can be made available as the equivalent of an ecological assets and liabilities statement as well as a profit and loss statement, as it were, which will reflect what we are doing to those assets and liabilities in an ecological sense.

By this I mean a statement of such detail and such scope as to permit this Nation to understand how to embark on a course which will assure the viability of at least our part of the planet in the future.

I am not being critical of the planning. I am simply directing myself to the very same difficulties which you found and are evident in your report. Particularly, this stems from the fact that it is not within the capability of the planners really to give complete direction to the program. In other nations with other forms of society and government, a central planning body could give orders to the scientific community and these would be followed out. In our society this is not doable. The planning body can develop an overall plan but it must then search for scientists who on their own volition wish to contribute to it in a meaningful way.

I am not at all certain that at this moment the sum of such voluntary contributions will get us to the goals which you have set forth

in this document, goals which I think are entirely appropriate. But I am not sure they are realistic for the program.

I have a suspicion that, only if the program were embarked upon on a somewhat larger scale than even the planning committee has discussed up until now, could one really get the kind of information and on the scale you will need one day in order to achieve your ends for this Nation.

Were the funds available, then I would be unable to say that we have the scientific capability to get on with the task. As the ecological community itself has said repeatedly, there is a woeful shortage of very good ecologists, adequately trained to undertake this task. This is not their fault. Ecology is new; the problems are new; and our awakening to the manner in which we have despoiled this beautiful continent is rather a novelty in the lives of all of us.

Until there are enough first-rate ecologists, I do not see how we can get to the place you anticipate in the report. I do not think it is possible to compound a first-rate program by using third-rate scientists. No number of third-rate scientists would get you there. And there are not now enough first-rate ecologists.

So I would hope that the program limits itself to the support of first-rate scientists doing first-rate jobs. How many of those there are and what they are capable of doing, I have to leave to Dr. Carlson and Dr. Deevey who make these judgments much better than I.

Mr. DADDARIO. Dr. Handler, you understand the committee suffers no illusions as to where we are presently. Our concern is how we can develop capabilities which in the future can meet needs which we see will be rushing on us in a fast-moving way.

Dr. HANDLER. This is exactly where the problem lies. Quite clearly the physical problems with which we are concerned are being generated at an enormous rate, our capability of dealing with them sufers a terrible lag, and I do not know whether we can catch up in time to avert catastrophe.

Mr. DADDARIO. We find it an interesting and a very healthy proposition as far as we are concerned, to see the growing dialog which has developed as a result of the beginnings which were involved in the International Biological Program itself, and the need to come to the Congress to get support, because within the scientific community there has been a conflict. If, in fact, there is beginning to be a better feeling, as you have indicated there is, because the molecular biologists are necessary to augment the quality and numbers who will be assigned to tasks which you all agree are important, then we have accomplished something already.

Dr. HANDLER. I think we have come to that time, but I would add one fact. From the standpoint of the kind of science my laboratory represents, ecologists are applied scientists and I have a very simple philosophy about applied science. It is much more difficult than fundamental science even though there seems to be a pejorative overtone to the word applied as it is used in academic circles.

The fact remains that successful applied science is extraordinarily difficult, and the task which is before the international biological program is both enormous in scope and extremely difficult to come to grips with, although molecular biologists may have now suffered a change of attitude. I do not think, however, they will be rushing into becoming ecologists.

Mr. DADDARIO. The committee is seeking advice and getting it from a multitude of persons such as pathologists, biologists, and physicists. You have been telling us what this program is about, what it ought to be doing, where it is going, and how it will get there. We have to classify and analyze it. We do agree with you that the applied activity is extremely important and difficult in this area and others. This is one of the reasons with advice from the National Academy in its last report why we have been looking into the national laboratories to see how we can, in fact, develop a better applied capability in this country.

From that standpoint, it is probably a healthy and progressive thing that the discussions about the International Biological Program are not separate and apart. They do fit into the whole scheme.

Dr. HANDLER. May I turn my attention to the real issue, which is the funding mechanism, if that is in order?

Mr. DADDARIO. I had assumed you had said something about that and wanted to avoid anything further. I was coming back to you later.

Dr. HANDLER. I haven't explained why I am embarrassed.

Mr. DADDARIO. You can disagree with our resolution and not be embarrassed because we recognize there is a disagreement about it. The only way we can discuss it is by putting something out before you and others.

Dr. HANDLER. I applaud the intent of the committee to provide funds which would make the IBP possible and run it on the scale which these gentlemen say is feasible and appropriate at this time. The funding mechanism, however, may not be well advised.

I sit on the boards of directors of several corporations. If, at the beginning of the fiscal year, the president of one of these three corporations suggested earmarking an activity out of the reserve funds, each of these boards would object, saying that either we can afford this or we cannot afford it. If we can afford it, let's budget for it; and if we cannot afford it, then let's not.

I suspect this is the position my friend, the Deputy Director of OST, must have taken yesterday in objecting to a mechanism which would take the funds from the President's contingency reserve.

Mr. DADDARIO. Those contingency reserves are just that. They are a wild estimate. There is nothing hard and fast applied to it. If it had been possible, those items which may sometime or other be supported out of the contingency funds, would already have been line items. So I don't know we necessarily find ourselves in an analogous situation.

Dr. HANDLER. I would rather defer to Dr. Bennett and the gentlemen who represent the Bureau of the Budget, but my point was only to state that, at this time, before the fiscal 1969 budget is hardened and signed into law, if these funds were to be made available to the Foundation, then I would hope we could get them in the normal appropriation process rather than by this mechanism.

Others than that, I would simply defer to those who represent the Bureau and the Executive Office.

The second half of the resolution relates to a line item in the amount of $5 million for the National Science Foundation for its role in IBP. I could be happy with that, as Chairman of the Board, were I certain that these were additional funds. Were they not additional funds, I would become somewhat uncomfortable with such a line item until it is

clear what action the Congress will take concerning the budget request of the Foundation this year.

A $5 million figure earmarked for the IBP in a year in which there may be severe blows to the Foundation's other programs, would be a bit difficult for us to live with. Further, to embark upon new commitments when we can not honor old ones would be, I suspect, not only a source of embarrassment but unwise in the total national picture.

Mr. DADDARIO. We will come back to that.

Dr. Deevey.

Dr. DEEVEY. Well, Mr. Chairman, I have not prepared a statement of my own, though I have had some input to the statements you have already heard in these hearings, and I am proud to have played that role.

If I risk speaking extemporaneously and risk saying things I might regret later, I would like to testify from the rather special, though in the Foundation's organization not unique role of the academic who has come to the Foundation on a tour of duty to serve as a research administrator. That is to say I have in my career occupied both sides of the table, as you heard the table yesterday.

I have been an academic applying for and receiving funds mainly from the National Science Foundation over a number of years. In one year, then, I moved from an academic post in which I was research director of a small program of the order of $60,000, with my staff, if I may put it that way, consisting of two quite independent and diverse postdoctoral people, one on a sabbatical leave from Australia, and one senior graduate student and peripheral people moving along into the program and one research assistant.

I have then gone from $60,000 a year administrator in 1 year to a $6 million administrator, and this has been a real revelation to me. Suddenly I have some kind of responsibility for the activities of 600 senior scientists who are spending $6.5 million worth of public funds and who have associated with them 1,200 to several thousand postdoctoral associates and faculty research associates and at least an equal number of paraprofessional staff, research assistants, graduate students, et cetera.

It has given me quite a new look at the way science is done in this country and a new sense of responsibility for administration of scientific affairs.

In effect, the thrust of your resolution insofar as it affects 1969 budgeting would be almost overnight to double my program. I stress that by the time such funds are available someone else from the academic community, and I trust several, I mean a larger number from the academic community or elsewhere, would be drawn into the management of the National Science Foundation. You might say, "What research administrator would not jump at the chance of having his budget doubled overnight?" I would, of course. But then I stop and think about my own experience.

Your committee has taken a look, at Dr. Blair's request in his testimony yesterday, at the managerial aspect of the IBP programs. He says on page 52 of your report you can see how the academic community has begun to organize itself for the managerial task in front of it. And I must say that as an academic and knowing what has been involved here and knowing in much more detail than shows in this

document, in fact, I am profoundly impressed by the way the academics have been able to organize their diverse activities, on paper at least, and to think out the site problems, the logistic problems, the advisory committee problems, and, to a degree, the funding problems, and I must also say that those academics who proposed this program don't really know what is involved. There is a whole different level, different layer, of managerial capability which now, for the first time, I am beginning to sense, and I don't expect Frank Blair or any of his colleagues to sense it unless he happens to sit in my chair for a while. A great deal is involved in managing these kinds of programs, even if they were to be wholly supported by the National Science Foundation or had only a little bit of joint funding from other agencies. We have some experience in joint funding with the National Institutes of Health, where a scientist's whole research program is jointly funded, sometimes in the context of a particular proposal, more often in the context of related proposals, one of which the man succeeds in selling to NIH and the other of which he succeeds in selling to NSF. These are not frightfully difficult to administer.

We also have a lot of experience with field-oriented biology, where a particular man is involved in a particular field project. When it comes to managing the activities of several hundred people of this caliber and capability all at once, I begin to get a little uneasy, because I know what has been involved in our review, as a program staff, of the grasslands biome study. It was not the Interagency Coordinating Committee that forced us to reduce this proposal from a requested $1.8 million to a presently requested $700,000. It was in large part our own judgment of the necessity for telling the scientists, "Cool it a little." "Take a somewhat harder look at what you are doing," we said. "Reorder your priorities, get rid of some of the things that seem at least deferrable and the others that could be eliminated to the benefit of the program, and come back to us with a revised budget amounting to less than half of what you propose for the first year."

This is, I may say, standard practice within the Foundation. Almost any senior scientist might expect to come in for a $120,000 project for 2 years, and find it "knocked back" to $75,000 after the staff and the reviewers, his peers, had a good look at it. In every case then we have a managerial process even within the Foundation which would take a bit of time to work out.

Where it involves interagency funding, not pair and pair, not just NIH and NSF, but NIH and NSF, AEC and ESSA, and so on, all at once, not to mention Agriculture and Interior, it is going to take even more time to shape these proposals into something that will not only be doable, and even more exciting when it gets started than it seemed to be at first, but also testifies as to the responsibility we in the Federal Government have for making sure the public funds are spent wisely.

Mr. DADDARIO. Dr. Deevey, are you referring now to that list that totals eventually $7.5 million which Dr. Blair was talking about?

Dr. DEEVEY. No, I am referring to a more confidential stage which doubtless should be off the record, but I am sure the Congress understands this is the way we operate at NSF, the stage between the submission of the grassland biome proposal by George Van Dyne of the University of Colorado and the present stage when a version of it is

ready in our opinion for approval. The original budget for the first year as requested was $1.8 million. With the Interagency Coordinating Committee having reviewed it carefully, but still with us, with our program, as the lead set of administrators who have to start the thing going we made them knock it back to $700,000. That $700,000 project proposes an exciting piece of doable research and I can reassure Dr. Handler it is of very high quality, that there is plenty of talent, that that talent has surfaced because of the imaginativeness of the project and it has brought into the operating purview ecologists who last year never thought they were ecologists.

In fact, they thought they were meteorologists and hydrologists or systems engineers, and half a dozen things that certainly weren't biology last year, but this is where the talent in ecology is coming from, and the project is now—in our collective opinion within the Foundation—a highly imaginative, highly manageable, though breathtakingly large, research activity. It has taken, though, between January and April—a very short time when I think of all the hand-carrying we had to do—to get it to that state. It has taken 4 months, and it should typically take at least 6 to shape what is already an exciting and interesting proposal into something that we can fund.

Even so, we need help from the other agencies in fiscal 1969. We will do our very best to get it. That suggests, though, that the other large major integrated programs, when they prepare their program statements, will have to have learned a lot from that process. They are watching; we have been keeping them informed; and we think of this as a prototype from the mistakes of which the other programs will learn. The fact remains that the earliest stages of management, as we see the management, are going to take time. When, therefore, my supervisors say $700,000 was an appropriate amount to ask for for IBP in fiscal year 1969, I am well aware that my predecessor in fact asked for $3 million, and "his program," so to speak, was knocked back to the $700,000 item. That is simply another aspect of taut management within the Foundation.

That is, above the USNC–IBP structure there is another layer at which "cooling it" or "taking a hard look" or "shaping it," all of these verbal phrases, are used; but this layer is confined to the Foundation, and the moment you touch interagency funding you have a whole new layer of managerial, administrative, and fiscal questions to investigate. So that I think I must say that I would defend the Director's position as of yesterday—and Dr. Bennett's, that sure—more money than $700,000 is going to be needed, quite possibly more money than we can possibly redirect even in the way we have already redirected funds in 1968—and most of those came straight from "my" program, I may say—but I think we could successfully—at least I could successfully, being one of them—tell my academic colleagues, take it easy, don't be quite so impatient, don't imagine that the failure to fund at that level in 1969 is going to be disastrous to the program. It will be uncomfortable, but it won't be disastrous, and in my considered opinion, it will be to the benefit of the whole program if we do go a little more slowly.

This doesn't put off funding until the year 1970 as one of my academic colleagues believes. Fiscal year 1970 begins on July 1, 1969.

It does require putting off quite a lot for a few months. It certainly does not require putting off the whole of IBP for a full year.

Mr. DADDARIO. When you say it puts out quite a lot of it, do you mean by that that it falls within this category of development which you believe in the final analysis is a healthy progress?

Dr. DEEVEY. Yes.

Mr. DADDARIO. Since we are talking not about all projects which come before the National Science Foundation, but those which in one way or the other come under the category of IBP, are we able to give the International Biological Program the kind of support it needs and should have?

Dr. DEEVEY. I will repeat that, sure, more money would be helpful; that a great deal more money is absolutely essential, I do not agree.

I would like to see that $700,000 item substantially enlarged, but I must say not at the cost of dislocating all the other programs within the National Science Foundation.

Mr. DADDARIO. There is no question Dr. Bennett was right yesterday when he said he personally had to take this into perspective consideration, which we all must. The committee finds itself here seeking advice. We wrestled, Dr. Handler, with the language of the resolution and recognized that there would be some contention about it. We are not in any way wedded to it. Our hope was that by getting it out in front of all of you we would be able to get some advice as to what we might do. We have had a great deal of advice. Dr. Deevey, you can advise Dr. Handler that these are first-rate people which is extremely important because all of this fits together. Then, Dr. Deevey, this brings us to procedure of funding on-going projects and bringing agencies together so that we would have a presentable participation in the International Biological Program, and so that by 1970 or fiscal 1970 we would have recommendations made which would determine whether we should continue as we are or whether we authorize and appropriate separately for IBP activity from that point. It seems to me that is what you are saying.

Dr. DEEVEY. It would be difficult for us to live with this decision, that is clear. I would say, though, it is not impossible. We would do our best.

Mr. DADDARIO. It would not be impossible and you would do your best. It would be your point that you would in fact, with funding restrictions, being less severe than now, learn more about the programs that have been submitted, having them go through the process which the grasslands program has already undergone and come up with something that would be healthier and more important.

Dr. DEEVEY. Yes, sir.

Dr. CARLSON. Mr. Chairman, I pointed it out, and I recall that the Director also pointed out, that the Program and the Division did provide close to $2.5 million for this program in fiscal year 1968, which I think demonstrates the points that Dr. Deevey was making here.

Mr. DADDARIO. I understand that, Dr. Carlson, but swinging back a little bit, doesn't that $2.5 million, or wherever we have in the total amount, include many programs we would be supporting anyway? They are ongoing programs. They don't come about simply because we are supporting the International Biological Program; but, rather, because they seem to be growing as the need has come along to have

a link with the International Biological Program. We and other nations find ourselves supporting in several agencies work of this category which we can very nicely assign to the International Biological Program activities, but which are not. They can serve both purposes; but we would be doing them anyway.

Dr. CARLSON. Right. Right. I agree fully with you, Mr. Chairman; but I would point out, that we are now backing the development of new programs. For instance, we would not—and I can be corrected by Dr. Deevey—have moved into the large biomed programs that we know are being developed and also that we presently have within the Foundation. So there is that aspect of it. Now, there are a certain number of these ongoing programs which, as Dr. Blair pointed out yesterday, are being intertwined into the total international biological program on the U.S. side, having been given the IBP label.

In short, we would have supported, I am quite sure, a number of these, and the National Institutes of Health, and AEC would also have supported them; but there are certain of these, I am convinced, that we do need new funds for. We have used $700,000, plus some regular program funds, to implement these programs.

Dr. DEEVEY. Dr. Haworth was ready to submit, in case it was called for, a breakdown of the $2.5 million.

Mr. DADDARIO. We would like to have that for the record.

Dr. DEEVEY. Some of it, I might say, is at a stage where we would be unhappy if we were obliged to release it. The point to be made is, that if all goes through as we hope it will, it can clearly be said that $700,000 at least was on-going and would have been done had there been no IBP; whereas most of the $1.7 million extra is clearly redirected toward IBP major programs and could not have been anticipated had there been no IBP.

Mr. DADDARIO. If we are to follow the advice which the majority of the witnesses before us supported, and that is to continue along present lines and obtain further information from additional studies, what effect is this going to have on the International Biological Program itself or participation in it? Will we in fact affect the forward thrust of our own prestige and of that of other countries? Do any of you have any feeling about that?

Dr. CARLSON. I would like to speak to that. I am firmly convinced that many of the countries, both across the Atlantic and in South America, are looking to the U.S. scientific effort in this area for leadership.

As Dr. Blair ably pointed out yesterday, he was able to see this very evidently in the recent Varna meetings—the General Assembly of the International Biological Program. Many of the developing nations also are looking to the United States for guidance and for help as far as food is concerned and a better way of life. As far as I can see, this was its general approach.

I don't know whether Dr. Deevey will speak to this or not.

Dr. DEEVEY. I have been in two international conferences in South America and I must say that the Latins, at least, are ambivalent about this matter of U.S. leadership in IBP programs. They recognize Uncle Sam has most of the dollars, but do not admit that the United States has all the brains. I think the thoughtful intellectuals of Latin America are more concerned that the United States demonstrate intellectual

quality rather than retain fiscal supremacy. There has been altogether too much patronizing of Latin science by the flow of U.S. dollars. They, I think, would be more impressed if we refined the scientific leadership which is already clearly evident in the U.S. program and not worry too much about thrusting research dollars on Latin America until it can shape its own programs to match.

On the European side, I know the attitudes are different, the economic situation and scientific communities are different. But we can be very proud of the statement which the Director quoted in his testimony yesterday from the editorial in Nature last December. It said, "Having scrutinized the underlying concepts of IBP more thoroughly than any other community, the United States may now undertake work that is proportionately more significant."

This is music to our ears to have heard this from a British journal. I don't think that a slight diminution of the rate of effort, implied by not having $5 million for this purpose, all in NSF, all in 1969, will seem like footdragging to those who really understand how the U.S. Government supports science.

I think we will do pretty well and I am far more concerned about the conceptual than about the fiscal in that leadership.

Mr. DADDARIO. When you talk about the conceptual leadership, Dr. Deevey, and your feeling about the effect this will have on your involvment in this program with the South American countries, aren't you touching on a very important thing? Doesn't this give an opportunity to work with them under a relationship which puts them on a much higher level than they have been in the past and doesn't this give us a good opportunity in very important programs with very little expenditure of amounts in order to develop a better relationship?

Dr. DEEVEY. Yes, indeed. I am entirely convinced that this is the way to do it, and that some of our other experiments in doing it differently have had a negative rather than a positive effect.

Mr. DADDARIO. There is a great deal more that can come out of this program beyond just these ecological studies. We can in an international way develop a better relationship.

Dr. DEEVEY. But as of fiscal year 1969 it takes relatively few dollars to do that, in my opinion, because those few dollars are a few more than zero for mechanisms of this new sort.

Mr. DADDARIO. Dr. Deevey, I think we are just about to the end. I am not going to come back and ask Dr. Handler about the $5 million because the Congress, Dr. Deevey, goes through a process of asking for more than it gets. You haven't developed a new theory downtown. Do you have any questions?

Mr. YEAGER. Dr. Carlson, I indicated yesterday I would ask you this question. My impression is that outside of the National Science Foundation all the other agencies of the ICC are being very cautious about what you are going to do or how the IBP is affecting them. Everything is put in terms of might or could.

Dr. CARLSON. Yes.

Mr. YEAGER. In fact, is there money committed from any other agencies for phase two of the program in 1968 or 1969 for actual operational purposes?

Dr. CARLSON. There has been $25,144 for 6 months committed by the Air Force for the Eskimo program. Hard funds from 1968 and

1969 have been committed as I stated before for the overall support of the United States National Committee, but that isn't, I don't believe, what your general question is.

Mr. YEAGER. Have they contributed new dollars or reprogramed dollars for programs that the ICC has presently before it?

Dr. CARLSON. Other than the Air Force I can't recall specifically any other agency than the National Science Foundation. Now, in defense of that, I would say—and I am probably a very naive, young lad—I am convinced that the Interagency Coordinating Committee can work out certain types of funding procedures.

Now, it is recognized that many of these agencies work under specific laws and regulations and acts so that it is extremely hard for them sometimes to participate, but I hope to work closely with every single one of them and they will eventually, probably not all, but let me say a majority of them, participate in funding some of these major biome programs. For instance, the Forest Service, I can't help but feel, would be keenly interested and would try definitely to support, with dollars if it is possible, the deciduous biome program and the coniferous, one in the East and one in the West. They would definitely be involved in that and there are others I could bring to your attention.

Mr. YEAGER. If you find that there are additional hard commitments other than what you mentioned, would you mention them in the record for us, please?

(See answer No. 6 of Dr. Carlson's responses, p. 62.)

Dr. CARLSON. Yes, sir; I definitely will.

Mr. YEAGER. Another question. It is, of course, recognized pretty well that the one who pays the piper calls the tune, and probably it has to be that way. I am curious about the role of the National Committee and what it is becoming. The IBP, as I understand it, was thought of initially by ICSU and the International Union of Biological Sciences, then espoused here by the Academy of Sciences, and so on.

I have the feeling that the National Committee is now pretty much in the same position as anyone else who makes a proposal and that it is OST, NSF, and the ICC which have the final say on whether this shall be done. Of course, as those who fund it, this probably is to be expected. But how do you visualize the role of the National Committee? Do you think it is going to be, or is becoming, something more than an advisory group? And alternatively should it perhaps seek some funding from sources other than Government?

Dr. CARLSON. I know for a fact already that the U.S. National Committee has looked into nongovernmental funding very thoroughly, but whether they have been successful, I can't answer. Dr. Blair sits in the back of the room. He could probably give you an answer to this. Naturally, we would encourage participation on the part of private foundations. In fact I, as a member of the staff of the National Science Foundation, have often tried to encourage private participation in the support, for instance, of marine or inland biological stations and so I would say, yes, the USNC could and should do the same.

Now, I have forgotten the first part of your question.

Mr. YEAGER. This had to do with the role of the National Committee and whether it may become just an advisory group—or is it that now?

Dr. CARLSON. At the present time it is advisory to their own specific agencies——

Dr. HANDLER. The National Committee.

Dr. CARLSON. Excuse me. The role of the National Committee, as I see it is, that of designing a major research program and certifying its quality from the scientists' point of view. Now, this includes all of the types of programs that have been listed within your document and also within the documents they have put out. The National Committee also represents the interrelationship between national programs which I think is very important. I don't think we have stressed this enough. I think this is one of the ideal ways of getting along in this world that is quite mixed up in certain areas.

Now as to the Interagency Coordinating Committee, that must be more than just advisory. It must initiate action with respect to funding. Beyond that, through its subcommittees, it must examine and be satisfied about program management, how the scientists are going to undertake these larger programs without wasting funds, and without getting into each other's way.

Mr. YEAGER. I have one question I would like to ask Dr. Handler.

In our hearings last year, Dr. Gates, of Missouri, was a very eloquent witness and suggested possible establishment of a National Institute of Ecological Research.

Dr. HANDLER. As a laboratory?

Mr. YEAGER. No, I don't think he called it only a laboratory, but the idea was, as I recall, it might possibly be similar to the various national centers which the NSF now supports.

Dr. HANDLER. As a laboratory, then.

Mr. YEAGER. I think partly for ecology, but it would have to be more than that.

Dr. HANDLER. As a research organization doing research, not as a Government agency for funding.

Mr. YEAGER. My question is: Do you think, provided funds were made available specifically for that purpose, that the establishment of a new national center similar to NCAR, and so forth, would receive favorable consideration from the Board as a policymaking group.

Dr. HANDLER. I think it might well. As ecology gets to be "big biology" and requires larger and larger instrumentation arrangements, more and more expensive hardware, airplanes, vessels, then it may well be that we will have to depart from the system of relying entirely on universities as a basis and have a central organization and laboratory that would serve the entire national community, where scientists would go in and out and lean on the facilities and logistics of such an operation. That might be welcome. We do this, of course, for oceanography, where we have a series of such stations. I think the Board would be receptive to such a plan.

May I add one comment to what you are asking of Dr. Carlson? That is, that as you outlined the history of IBP from ICSU to IUB to the Academy, and so forth, I think you omitted from your statement the fact that there is now a kind of ongoing Federal commitment to this program, a commitment which has been recognized by NSF, a commitment which the Congress recognizes in this document.

That doesn't answer your question as to the role of the National Committee to be sure, but there is more than merely an arrangement

whereby individual investigators come to various agencies and ask for support for their own pieces of the program. There is an understanding; there is a national commitment to the total package, and that may bring us back to the $5 million line item in the sense that it raises the question as to whether or not there should be sheltered programs for the support of the various pieces.

Mr. YEAGER. What kind?

Dr. HANDLER. A sheltered program, a program in which you do not ask that each project to compete with all other forms of science, but only with each other inside the program. In effect, a line item in the budget just about does that because within a line item program only the related projects are competitive.

Mr. DADDARIO. You do now have a line item in the National Science Foundation's budget at the moment and that would take some doing in itself.

Dr. HANDLER. Yes. What I was going to say is I am both concerned about it and support it at the same time; concerned in that the absence of a sheltered program assures the quality of the total program, if you will, because all aspects of science are competitive, at least within Dr. Carlson's total package of biological programs. It may be that the IBP needs a certain amount of shelter because it is the beginnings of a kind of big biology, and the sums involved seem very large to a panel of biological scientists.

I am sure this is Dr. Deevey's experience, that the people who provide advice to the Foundation with respect to the quality of projects are likely to look with a jaundiced eye at project requests with very large price tags, yet the projects relevant to IBP must be large and expensive if that program is to be successful. It cannot be successful as a program built of bits and pieces. So, to some extent, a sheltered program is useful.

Mr. DADDARIO. Although there is some contention as to where we are at the moment as we try to find out what we need, we are beginning to get to the point where we can make a determination.

Dr. HANDLER. Must.

Mr. DADDARIO. Dr. Blair, do you have anything you would like to add?

Dr. BLAIR. Thank you for the opportunity. I would simply express my own appreciation at the amount of attention that has been given to this matter, and I would like to repeat the statement I made yesterday that I think there is going to be a serious loss of momentum if we do not have some new funds in 1969.

I appreciate thoroughly Dr. Deevey's statements. I think these are well taken, but, nevertheless, I do know the difficulties that we have been faced with in trying to get some of these programs started with current funds. I refer again to the migrant peoples population program which I think is one of the most pressing approaches to current social problems in this country and which has not been funded. It is before a granting agency for review, but we have no certainty at all.

I stand on my position of yesterday that we are going to lose momentum in a serious way if we do not in some way increase the number of these programs that can be started at some level in fiscal 1969.

Mr. DADDARIO. Thank you, Dr. Blair.

Do you have another point?

Mr. YEAGER. No.

Mr. DADDARIO. Anything you gentlemen would like to add?

(No response.)

Mr. DADDARIO. We thank you all. It has been extremely helpful. Dr. Blair seems to be the minority side, but we are considering everything you said, and we agree that these programs, such as the one you just mentioned, do deserve support.

The committee finds itself in a much better position than it did 2 days ago. With the facts before it, perhaps it can come to some conclusions of its own and certainly some adjustment of the resolution before it.

We thank you all.

(Following are responses by Dr. Handler and Dr. Carlson to committee questions:)

RESPONSES TO SUPPLEMENTAL QUESTIONS, BY PHILIP HANDLER

Question 1: What is the sense of the National Science Board with respect to the IBP?

Answer 1: The position of the National Science Board vis-a-vis the International Biological Program has evolved as national planning for the Program has become more sharply defined, the objectives more precise and some of the actual projects to be undertaken have taken shape. The Board sympathizes with and endorses the overall objectives of the Program—a thorough analysis, qualitative and quantitative, of those factors which determine the biological productivity of planet Earth, long term and short term trends, future prospects and the role of man in the system. There can be no disputing the immense significance of such understanding if the planet is to remain viable.

However, the Board is uncertain of the adequacy of our national resources—in competent scientists and necessary facilities—as these relate to IBP planning. Nor is it clear ecology is sufficiently mature a science to undertake systems analyses on the appropriate scale. For these reasons, the Board prefers to approach the IBP with some caution. False starts, expensive but scientifically inadequate projects could not only injure the IBP itself but result in serious delay in attaining the ultimate objectives toward which it is designed. Hence, the Board is presently opposed to a 'sheltered program' within which IBP endorsed or related projects would compete with each other but escape examination in the more rigorous context of the ongoing programs of research currently supported by NSF. However, the Board does welcome the opportunity to support well conceived and planned projects under the aegis of the IBP, within the constraints imposed by the balance of resources available to the Foundation and the obligations of the Foundation in all the diverse areas of science and science education.

Question 2: Does the Board consider the development of theoretical ecology to be important? If so, to what extent is it willing to push for support through the NSF for such development?

Answer 2: the Board and Foundation have long recognized the great importance and future potential of ecology and NSF has been the principal source of Federal support for this science. I am somewhat uncertain of the meaning of the term "theoretical ecology." The Foundation is eager to support efforts to convert ecology from a qualitative to a quantitative science capable of both sophisticated analysis and prediction of the consequences of alterations in one of the multitudinous variables operative in an ecosystem. Again, the "extent" to which such a program can be supported must be understood in the light of the usual constraints and the current uncertainties with respect to the levels of funding to which NSF and other science supporting agencies may look forward for FY 1969 and thereafter. Were funds not limiting, I am confident that the Foundation would be most pleased to give program emphasis to first rate efforts in ecological analysis.

Question 3: Irrespective of the merits of the IBP as presently programmed, does the Board concur that contemporary problems of environmental quality demand a rapid improvement in ecological understanding?

Answer 3: The Board is agreed that our planet is in danger. Man has become the most significant variable in the planetary ecosystem. He grows in numbers,

deforests the timberlands, overcultivates, overfertilizes, converts the carbon of eons of fossils into CO_2, and showers land, fresh and marine waters with a brew of organic chemicals which are, themselves, triumphs of his technology. Quite conceivably, catastrophe lies ahead. Ecology is the branch of science whose objective is understanding of these problems, understanding imperative to the national and international planning required to safeguard our planet for tomorrow. Quite clearly, there is a sense of urgency, indeed anxiety that ecology, as a discipline, be developed as rapidly as our human resources will permit.

But the pace of such development does not rest exclusively with ecologists or the level of federal funding. There are very few "principles" of ecology. Ecological analysis is, necessarily, a synthesis of the understanding gained by the practitioners of numerous other disciplines: hydrologists, climatologists, botanists, zoologists, horticulturists, pomologists, agronomists, virologists, nutritionists, biochemists, geologists, etc., etc., etc. And ecology can only progress to the extent that these disciplines will permit. Indeed, to judge from history, it is quite likely that the ecologists may not know where the bottleneck in their understanding really lies. If, for example, there is an unknown chain of events such as a virus specific for one strain of corn and which grows only when water is overabundant unless some soil element is deficient—the ecology of such a stand of corn would remain entirely puzzling and obscure if one were unaware of the existence of the virus. And such situations are legion. Accordingly, as in much of science, one may not be able, successfully, to force feed ecology, merely by supporting ecologists. No amount of money given to engineers would have achieved power plants based on nuclear reactors or television sets until physics had supplied the basic understanding of nuclear fission and of the nature of phosphors. With these caveats understood, the Board agrees that it is in the national interest to mount as vigorous a national program in ecology as our supply of competent ecologists and their students will permit.

Question 4: In your testimony you described the work of the IBP as essentially "applied" work and therefore very difficult. Was this a figure of speech? Otherwise, how does support for the IBP jibe with NSF's present inability to support applied research?

Answer 4: As your Committee has heard repeatedly, the terms "basic" and "applied" have no absolute definitions: there is a broad zone of research where assigning one or another of these terms is entirely a problem of semantics which is resolved by asking questions concerning the motivation and environment of the investigator.

As we have already noted, ecology is not so much a fundamental biological discipline as it is the synthetic utilization of many such disciplines, together with those sciences which describe the physical environment, to gain understanding of the relationship which obtain among all the species dwelling in an "ecosystem"—a cornfield, a pond, a forest, a lake, a valley, or a continent. In this sense, ecology is to the biological disciplines—broad and diverse as they are—what atmospheric science is to physics and chemistry.

Even as he searches for the guiding, general principles, an ecologist is developing a derived science as does an atmospheric scientists or an oceanographer. And in this sense, even he is an "applied scientist". So too is the pathologist who is trying to understand a disease. But as long as he is seeking understanding which, hopefully, others will use to good effect if he is developing models and testing them, the Board, like the Director and his staff, consider that such studies are entirely proper within the charter of the Foundation. We welcome the clarification provided by HR 5404 since, once and for all, it would remove an inhibition of dubious meaning and less value and encourage the Foundation in other, clearly "applied" areas. The Foundation would remain unlicensed to support those endeavors which are entitled "development" and we consider this to be entirely appropriate.

Withal, my remarks concerning the difficulties and complexities of ecological research remain valid—and for much the same reasons as characterize first rate "applied" research.

RESPONSES TO SUPPLEMENTAL QUESTIONS BY HARVE J. CARLSON

Question 1: On the basis of your knowledge to date, which agencies of the ICC do you believe would be most likely to provide some additional funding for the IBP during fiscal '69?

Answer 1: As I stated in my testimony of May 2, we have good evidence that the IBP efforts are met with interest and concern by members of the ICC–IBP. Some agencies have already provided support for some of the integrated programs and others have such proposals under consideration. Statements of involvement in IBP activities for each of the member agencies will be supplied in the near future. The provision of additional funds for IBP for Fiscal Year 1969 by some of these agencies cannot be estimated. If the IBP proposals now under consideration are approved, some funding will be made available in Fiscal Year 1969. Although some of these proposals carry rather sizeable budgets, it is my belief that they can be supported through normal funding mechanisms. Specifically, the Department of Health, Education, and Welfare has before it a proposal for the International Study of Eskimos, and another requesting support for the Migrant Peoples Program.

The problem of funding the six biome studies under the Ecosystem Analysis program will, however, soon be acute. The budgets for these proposals are of a magnitude which presents difficulties for single agency funding under the current budgetary restrictions. I have had only one commitment for participation in the funding of these large programs by other agencies. Except for the provision of the grassland site by ARS and the involvement of other Federal personnel, the AEC is the only agency which has promised to help with Fiscal Year 1968 funds. At the present time, the Foundation is considering an initial award for the Grassland Biome of $350,000 for a six month period. This will permit the initiation of a curtailed effort in the first of the six biomes. In summary then, a few of the proposals of relatively small magnitude may be approved in Fiscal Year 1969 and funded through normal mechanisms. For most of these, additional funds may not be required, although I would suspect that the support actually provided would be at a level much lower than that requested. There is no indication at the present time that agencies other than the AEC can help us to support the costly ecosystem analysis programs in the next or future fiscal years.

Question 2: Do you believe that the narrow view of old line mission-oriented agencies with regard to how their funds must be spent tends to work against the funding of the IBP under current arrangements?

Answer 2: I am not entirely familiar with the details of the budget procedures for many of the mission-oriented agencies. However, it would appear that for many of these agencies the use of funds is severely restricted to earmarked programs, thus preventing action by representatives of those agencies who may be interested in participating financially in the IBP program. If I assess the current arrangements correctly, they do indeed, seem to work against the funding of the IBP.

Question 3: Would it be helpful if Congress provided a resolution authorizing agencies of the ICC to transfer funds for this purpose? In other words, would such Congressional action ease the minds of the agency administrators on this point?

Answer 3: A general resolution from the Congress authorizing agencies of the ICC to transfer funds for support of the IBP probably would have little effect. However, a resolution or act which specifically amends each of the several separate acts appropriating funds to each of the member agencies of the ICC probably would accomplish the purpose by indicating the intent of the Congress in such a way as to minimize ambiguity. An alternative having the same effect would be for each such appropriation act to be enacted by the Congress with such a provision (authorizing transfer of funds for support of the IBP) included at the time of enactment. Otherwise, both the provisions of the appropriation acts, and the legislative history of each, would tend to preclude a general resolution of the Congress concerning the IBP from having much effect. In discussions I have had with ICC–IBP members, I sense that only through such Congressional action would funding for IBP be made possible.

Question 4: Is it your opinion that operational funds for the IBP in fiscal '70 will be substantially more than has been made available to date? (This assumes, of course, that further security emergencies do not develop or present ones are not greatly aggravated.)

Answer 4: It is my personal belief that more funds for IBP will be available in fiscal year 1970. It can be expected that by fiscal year 1970 there will be a backlog of meritorious IBP proposals which have either been funded at a greatly reduced rate or have not been funded at all, providing evidence that additional funds are indeed necessary and that good research plans can indeed be developed under this program. In addition, the program memorandum to be prepared for the Bureau of the Budget should present documentation in a more detailed way than heretofore stated for additional funds for fiscal year 1970. If further security emergencies do not develop, I believe that a good case can be made for budget recognition of IBP.

The budgets of IBP proposals now under consideration in the Foundation, and those which we can foresee as emerging early in fiscal year 1969 are sizeable. If favorably reviewed in the next fiscal year, we must choose to either fund at a minimal level or delay final action until fiscal year 1970 when, hopefully, budgetary restrictions may be less severe. When we have had additional experience in examining the proposals for the major IBP integrated programs, we can better assess our needs for fiscal year 1970.

It can be assumed that the activities of the USNC will decrease relatively as more programs emerge from the planning phase and enter the operational stage. As these programs emerge they will be submitted as research proposals to either ICC–IBP as a whole or the appropriate Federal agency depending on their magnitude. If management and research operations of each major program are to be funded under the umbrella of one comprehensive award for a given program one result might be that funding requirements for the USNC–IBP would decrease as research operations get under way.

Question 5: In your opinion, would a National Center for Ecological Research, similar to the NCAR arrangement, be a valuable tool not only for basic ecology but for the purposes of the IBP?

Answer 5: I have examined a preliminary report on an ecological institute by the Ecological Society of America (ESA). The plans for such an institute are still provisional so I cannot make detailed remark on its feasibility or its final organization. Further plans are under development. In principle, however, I endorse the aims of the ESA to develop such an institute, whether it has one or several centers, and feel that it would have a beneficial effect on the development of the state of that area of science known as ecology. Although the thinking of the ESA on an ecological institute and the development of the U.S. IBP efforts ran along parallel lines, for some time there did not appear to be any crossover. Recently, however, as IBP planning became more advanced, it became obvious that one of the important problems to be faced would be that of handling the enormous amount of data which will accrue from the program. One possible function of the ecological institute would be that of a computer center. It would be most appropriate if the institute were to serve as such a center for IBP data. Beyond this I cannot now predict the further mechanisms of interaction between the IBP programs and the ecological institute. These may very well emerge as both activities become further developed.

Question 6: Does the information available to you suggest that a delay of a year in getting Phase II of the IBP well underway would be severely detrimental to the program as now planned?

Answer 6: Dr. Blair has testified that a delay in getting Phase II of IBP under way in Fiscal Year 1969 would be disastrous. Although there may be some curtailment of research activities, and a delay in funding of a few months, I am not convinced that the effect will be deleterious to the program. Indeed, the program could benefit by the additional few months time in firming up some of the details of the research plan. This is not to say that all of the program can be put off for an additional year. We now have under consideration several proposals for integrated programs. These will be reviewed in June for possible funding in Fiscal Year 1969. If these proposals are approved, and if sufficient funds are available, some funding can be provided in Fiscal Year 1969, but at a much reduced scale.

We are aware, however, that other proposals for integrated programs will emerge shortly. Review of these will take place late in this calendar year or early in the next. These are the proposals which probably cannot be funded in Fiscal Year 1969. They will be carried over, if recommended for support, into Fiscal Year 1970. These proposals are likely to carry large budgets. Thus, we can anticipate entering Fiscal Year 1970 with a backlog of proposals for several major, integrated IBP programs. Without a considerable increase in IBP funds beginning in July 1969, we shall really be in budgetary difficulties, and then I would agree with Dr. Blair, IBP would be in a disastrous state.

Mr. DADDARIO. This committee stands adjourned until the call of the Chair.

(Whereupon, at 11:45 a.m., the subcommittee adjourned to await the call of the Chair.)

APPENDIX A

Additional Material and Communications

University of North Carolina,
Chapel Hill, May 1, 1968.

Hon. Emilio Q. Daddario,
Chairman, House Science and Astronautics Committee, Subcommittee on Science Research and Development, Rayburn Building, Washington, D.C.

Dear Sir: The program director of the US–IBP, PT–PF Section, Dr. Smith, suggested that all of us who are actively involved in the US–IBP effort should send supporting letters to your office. It is a pleasure for me to do so as the present chairman of the preliminary steering committee of the Eastern Deciduous Forest Biome as well as an individual who has been involved in the organization of the IBP for several years.

We have been informed also through several sources about the excellent report entitled: *The International Biological Program, Its Meaning and Needs*, which your committee issued on 20 March 1968. May I ask you in behalf of the Research Triangle IBP Study group (Duke–UNC–N.C. State) to send me three copies of this report, one for each University.

Accompanying this letter, you will find my own justification for the participation in the IBP, and the philosophical reason for spending much of my time in recent years in getting the IBP off the ground. Copies of this letter will be sent to the representatives of North Carolina in Washington, especially to Senators B. Everett Jordan and Sam J. Ervin, Jr. and Congressman James Gardner. The appendix accompanying this letter will be distributed among our colleagues interested in IBP studies.

With kind regards,
Sincerely,

Helmut Lieth,
Chairman, Preliminary Steering Committee of the Eastern Deciduous Forest Biome, US–IBP and Coordinator of the Triangle Universities IBP Project.

THE URGENCY OF THE INTERNATIONAL BIOLOGICAL PROGRAM JUSTIFIED FROM A GEOBOTANICAL-GEOPHYSICAL VIEWPOINT

APPENDIX TO THE SUPPORTING LETTER SENT TO DR. EMILIO DADDARIO, CHAIRMAN, HOUSE SUBCOMMITTEE ON SCIENCE RESEARCH AND DEVELOPMENT

(By Helmut Lieth, Chairman, Preliminary Steering Committee, US–IBP Eastern Deciduous Forest, Chapel Hill, April 1968)

The objectives of the International Biological Program were formulated as the study and improvement of biological productivity and human welfare. This covers a wide range of possible biological investigations and essentially includes also agriculture and forestry. It was, therefore, at the beginning of the International Biological Program, somewhat difficult to convince our colleagues working in a variety of related fields that a world-wide program especially devoted to productivity and human welfare was worthwhile and also essential for the survival of the next generation. The problems can be divided into three different categories:

1. The productivity characteristic of the earth.
2. The ecosystems and turnover.
3. The consequences for mankind now and later.

1. THE PRODUCTIVITY CHARACTERISTIC OF THE EARTH

(*a*) *Ecological efficiency*

Photosynthesis, the basis for the overwhelming majority of life on earth, is energy demanding. Solar energy is the normal source for this process and only a fraction of the energy from the sun is finally bound as chemical energy in plant material. The so-called ecological efficiency—that is the per cent of sun energy converted into the chemical energy of organic compounds—seems to be smaller than 2% of the total incident solar radiation in the tropics and under 1% in the extratropical regions, both under humid condition. Under stress conditions of any kind this fraction diminishes substantially until it reach zero in areas which we call deserts.

Although it appears to be true that solar radiation is not the limiting factor for biological production in the most productive parts of the world at present, it is very important to compare ecological efficiency under the various conditions on earth. Since the International Geophysical Year has provided us with better maps of solar radiation intensity on the earth's surface, it is only logical that the ecologists follow with a similar evaluation of the present biological productivity in terms of caloric values. As a matter of fact, it was among the conclusions of the IGY that the biologists follow with such an evaluation. This is clearly an objective in itself. Agriculture and forestry are mainly concerned with yield (the commercially utilizable portion of the total production) or with the production characteristics in their own environment rather than in a world-wide perspective.

I have made the first attempt to present the productivity of the earth on request from a group of geophysicists. (Lieth 1964/65). This shows the problems in drawing such a map at this time better than in providing factual information; but it is useful in discussing the key questions that appear during such an undertaking, and it has served this purpose ever since it appeared. The first revision of this map was recently made by Bazilevich and Bodin, 1967. This, however, is still insufficient, and it seems obvious that such a task can only be solved, with appropriate accuracy, through an international cooperation.

The question remains: Why do we need such information? The investigations of the present ecological efficiency and its comparison to the potentially possible level tells us the amount of unutilized solar energy, that is, the energy reserves which we still possess, assuming that we can maintain in the future all other limiting factors at a satisfactory level.

(*b*) *The productivity and its importance*

There is another internationally important demand for accurate knowledge of the productivity level on earth. Primary production (fixation of solar energy to chemical energy by green plants) is the basic support for essentially all life on earth, including man. The primary productivity ultimately determines the size of the human population and it is therefore necessary to know the level of this essential resource as accurately as possible. Here, again, we need to mention that the important figure is not the yield, but the productivity and the efficiency with which the energy is fixed and transmitted. This task is again different from the aims of agriculture and forestry. It is a matter of national and international importance and, in my opinion, the task of our generation to elaborate.

The evaluation of the above-mentioned productivity map by geophysicists (Czeplak, 1965) indicates a level of about $38(\pm 7) \cdot 10^9$ metric tons carbon fixation per year for the total land surfaces. This is double the amount that was usually estimated by previous authors. This figure seems to fit with the measurable fluctuation of the CO_2 content of the atmosphere throughout the year. The IBP must bring us better values and a denser network of observations so that the estimation of the total productivity becomes more accurate.

2. THE TURNOVER OF THE BIOMASS IN ECOSYSTEMS

(*a*) *General considerations*

I have tried, so far, to explain the need for an international effort in the estimation of the productivity level of the earth's surface, but the information gained from such an effort would hardly meet our future needs for managing the biological resources if we were not concerned, at the same time, with the way in which matter cycles. Primary productivity must be understood as one aspect of the gigantic cycle of biomass that is occurring on the earth's surface. The other aspect is the remineralization of this matter into the original chemical compounds such as CO_2, H_2O and ash minerals by the various consumers and de-

composers, including man, that live from the primary producers. Although scientists have been working on this matter for nearly 150 years, we understand only a few of the basic principles, because of the enormous task of registering only the number of different species involved, not to mention the effort of evaluating the portion that each taxon population turns over. The most successful attempts in solving this problem were made by a Russian team (Sukachev and Dylis, 1964 and Molchanov 1961) and by H. T. Odum in a rain forest project of Puerto Rico (in print).

(*b*) *National aspects*

Of course, one could say that the task of studying the turnover of biomass at a given point on the earth does not need any international effort. This might be true if we were only concerned with that one spot, but we need the same information from at least one representative biocoenosis within the major vegetation formations on earth in order to make comparisons and to test models which might allow us to manage natural communities in the future even under delicate environments.

The emphasis on the internationality of this project lies, in part, not so much in the objective itself, but in the necessity of sharing the knowledge of specialists wherever they are: in the necessity of training new students from the four corners of the world; and in the necessity of covering all major vegetation types of the earth, regardless of the ability of the countries involved to provide the manpower and scientific equipment to carry out such studies. This task is not so much a matter of foreign aid policy, but a necessary and integrated part of the total of the program. The impotrance of this portion of the IBP can hardly be overestimated, as I shall point out in part 3.

The investigation of biomass cycling has one further aspect of importance—regardless of internationality—for each human population that owns large industrial centers and employs the latest inventions of science and technology for all its needs. That aspect is that fact that man changes the turnover characteristic of biomass in a severe manner, resulting in air and water polution as well as environment deterioration. E. S. Deevey has pointed out some of these problems in his recent letter "Why an International Biological Program". Indeed, if we ecologists are consulted at all by society today, it is always in relation to landscape conservation, and air or water pollution. If our colleagues from sanitary engineering ask us about the possible impact certain pollutants may have in certain environments, we must admit that we do not, in most cases, know. The main reason for this is that, until now, neither appropriate equipment nor funds were available to gether the necessary quantitative information. Our generation of scientists has for the first time the necessary tools and methods to approach the analysis of complicated biological systems once human society is ready to pay the costs. The time is certainly mature now and the IBP has already stimulated many young people to devote their time to this task. All they need is to the moral and financial support.

(*c*) *Worldwide aspects*

In the same way we investigate the turnover of biomass in a given enivronment, we can calculate the turnover of the entire world, once we have adequate figures for it. In order to show how we will do this, I have included here a compilation of data from literature searches which I published in 1963. This table includes only the carbon balance, but we need to elaborate the same for nitrogen, phosphorus and other essential ash minerals.

The carbon balance of the earth

(From compilations of Mueller, Noddack, and Gessner)

Storage of carbon in 10^9 metric tons in:	
Atmosphere	697
Hydrosphere	35, 420
Geosphere:	
Inorganic carbonates	18, 300, 000
Inorganic noncarbonates	6, 800, 000
Older organic compounds	7, 400
Younger organic matter:	
In the ocean	3, 220
On the land	710
Biosphere:	
In the ocean	10
On the land	124

From this account, only the following factors are of immediate interest: the total amount of carbon in the atmosphere; its total amount in the biosphere; the younger organic matter on the land; fractions of the storage in the hydrosphere; and the older organic compounds. Those are the portions of carbon that move steadily through the biosphere and have a longer or shorter endurance time therein.

The figures in this table are certainly not accurate, especially the figures for carbon content of the biosphere show a wide range of opinion among the various scientists that have worked in this area. This question itself justifies partly an international biological program. But however the figures may be the turnover at the present time is such that the remaining CO_2 level amounts to 697 x 10^9 metric tons of carbon in the atmosphere. If we slow down the rate of CO_2 uptake from the atmosphere and, at the same time, blast enormous amounts of CO_2 into it by burning organic fuel from geologically older organic deposits, we will increase the CO_2 level to a yet unknown amount and alter the environmental conditions on earth rather severely. If we, on the other hand, slow down the decomposition rate of the organic matter that is presently circulating through the biosphere to a degree that exceeds the fuel combustion, we will experience a considerable shortage of CO_2 in the atmosphere which will greatly effect the production of our crops.

The present level of CO_2, some 0.03 vol % of the air is obviously adequate for human life and for a reasonable production rate by green plants. This level reflects largely the balance between all factors that either produce CO_2 or remove it from the atmosphere, and must be carefully watched. The responsible agent for the balance is the biosphere and especially the green vegetation cover. It is therefore essential that we learn as much as possible about the possible impact on the present biosphere components before they are changed.

The legal and moral aspects of this, as well as the previously mentioned productivity characteristics of the earth's surface will change the future international relationships and the customs of the future industrial society so drastically that we can hardly imagine the changes today. But they will come upon us so fast that every possible effort must be made to understand and to guide the processes before any damages occur. Let me explain some of these aspects in the next section.

3. THE CONSEQUENCES FOR MANKIND NOW AND LATER

Scientists do not usually think about the usefulness of their investigations to society. This old tradition is slowly deteriorating since it is becoming so obvious that the results obtained may result in potential disasters for society. In our case, the future bears severe problems if we do not speak about our results, and if we cannot convince society to accept our thoughts and to understand the need for our proposed studies.

In order to clarify the details I wish to describe, I want you to imagine the conditions on earth which we will have in a few decades in spite of birth control and family planning. Let us assume the human population of the entire world reaches the level of 10 billion and that the industrial potential is ten to twenty-fold its present level. At that time, mankind will be such a powerful force upon the natural resources that man himself, and not the vegetation as it does now, will control the quality of the entire atmosphere. Let me give a few examples, concerned on one side with either the productivity level of the ecosystems or the turnover characteristic of the biomass, and on the other side with a regional or a world-wide level.

Regional Productivity Problems

These problems already exist under present circumstances. Wherever we find a large industry pouring pollutants into the air or releasing it into the streams, biological production is affected. There have already been many cases where some commercial crops are incompatible with certain industries. At the moment we only see the striking effects that copper mills and similar industries have. However, the low percentage effect that certain air pollutants such as dilute SO_2 definitely have on yields at present is not clearly evident but will become a serious problem by the time the industrial centers form a closer network in the then more densely populated countries. With the necessary increase of farmed land, the loss in yield will be much more striking than we experience now.

Regional Changes in the Turnover Characteristic

The output of waste, certain industrial products such as pesticides and detergents, as well as man's present practice of sewage management already have led

to serious problems in the turnover of the biomass. I do not refer to the deplorable appearance of our streams, ponds, and lakes, but to the fact that the matter circulation is either retarded or altered.

The alteration of matter circulation is, at the moment, the most prominent source of disputes between industrialists and conservationists. It is very difficult to judge, at our present stage of knowledge, what can be replaced with what without any danger. By danger we mean two different aspects of the matter cycle. First, the maintenance of the productive power of a landscape regardless of the green plant species that produce, and secondly, the variety of species (plant or animal) which we still see in natural communities at this time, but which are slowly being depoverished. The arguments in this dispute are filled with emotion on both sides and it is a very difficult matter to touch, but nowhere is it more clear that we need to replace emotional reactions with rationally based scientific conclusions.

The IBP is planned to incorporate such studies. Contributions to the conservation of healthy environments, natural beauties, and rare or endangered species are included. These are likely to be pace setting for the immediate future. The problems themselves may be solved in many regions, and in general we expect to find methods for the quick investigation of future problems whenever they arrive. With a successfully conducted International Biological Program we expect to have the appropriate knowledge, manpower and appreciation by society for the need of such studies before major impacts by man upon a given piece of nature occur.

It should be clearly said here that if we fail to convince our political and industrial leaders that the conservation of a healthy environment is the ruling force for the future industrial society, we have lost even if the other IBP goals are otherwise successfully achieved.

World Productivity Problems

The really striking new ideas from the IBP effort can be expected to be an enhanced world-wide view. The relation between food production and human population is too obvious to be cited again. Rather, I shall concentrate on the combined human impact from industries, consumers, and social activities in the near future.

From the table and the productivity figures we can say that 697×10^9 metric tons of carbon in the atmosphere are moved through the biosphere with the present turnover rate of 38×10^9 metric tons carbon a year. The seasonal uptake characteristics of the vegetation in the extratropical regions of the northern hemisphere result in a considerable drop of CO_2 in the temperate zone atmosphere during late summer. (Bolin and Keeling, 1962). These drops will be much more severe once the total possible surface of the world becomes cultivated. Today the largest portions of the tropics and subtropics are either desert with little production or evergreen vegetation with no seasonal rhythm of production. Hence both are without any impact upon the CO_2 fluctuation of the atmosphere. If these areas come under the agriculture of the present day and large amounts of their yield is shipped to the temperature zone's denser population, we can certainly expect a strong seasonal change in the CO_2 content of the tropical atmosphere. This fact might not affect the total productivity figure of the world at all, but it will likely affect the relative production volume over larger areas of the world. Since the spring starts earlier in the southern part of the northern hemisphere, we can expect the subtropics to increase their agricultural production in the future partly at the expense of the temperate zones. The early production year in the tropics and subtropics already utilizes the increasing CO_2 peak building up normally at this time in the northern hemisphere which would otherwise be assimilated by the temperate zone crops. There is no justifiable estimate yet possible for the size of this impact upon our own agriculture, but the potential decrease in crop yield is there. The legal or political consequences which such a situation might create is unforeseeable. In the meantime, we must be concerned with what effect the expectable changes in the world's atmospheric CO_2 pool can have upon the yield in the various regions of the world rather than waiting until these things happen.

The same is true with industrial pollutants that might decrease the productivity of the green vegetation cover. We warn our politicians often of the importance of keeping the productivity at the present level at least. The loss in surface area of green vegetation cover from the lands which man needs for buildings and roads may be compensated by the adjacent vegetation, but it will

be catastrophic if something would happen to that vegetation which severely reduces its production capacity. The result will be an increase in CO_2 level that will only mark the beginning of a yet unpredictable chain of environmental changes on the surface of the world.

Many of the problems which I present here will almost certainly come in the future. The population growth itself will necessarily bring us to the margin of some of the possibilities before we can stop it. The industrial progress will definitely do this, and we must start elaborating the knowledge today that we will surely need tomorrow.

Worldwide Matter Turnover Problems

Some of the described productivity problems are already problems of regional changes in the turnover characteristics of organic matter. I would like to add only one more point. It is very likely that we shall increase the annual carbon fixation rate for the entire land surface of the world to double the amount which we now have. This means that the CO_2 content of the atmosphere will travel twice as quickly through the biosphere as it now does. At the same time we must speed all the other necessary components of the biomass in a similar order of magnitude. The quantitative aspect of the cycling of the other components of the biomass is understood even less than the one for carbon. The relation of the cycling speed of the various elements through the biosphere and its individual environments, in all different vegetation types and climates is something we need to know very soon.

FINAL CONCLUSIONS

For all of us who continually think these matters over, the described problems are no longer academic affairs. They are not merely speculations, but they are facts which contain hardship and insecurity for the next generation, if not for our own age. The only disagreement is over the time of occurrence and the direction of the unbalance.

We as scientists have the responsibility of bringing these matters to the attention of society. There is only a short time left for the investigation. In my opinion, successful operation of the IBP is essential for the survival of mankind. What we elaborate in this program will allow us to predict our future needs. At this very moment it is our obligation to suggest the necessity of such a program to the leading politicians. The responsibility now lies in their hands.

SUMMARY STATEMENT

Program on the Ecology of Migrant Populations

(For Meeting of the U.S. National Committee of the International Biological Program, April 30–May 1, 1968)

(Prepared by Demitri B. Shimkin)

The planned research effort on the Ecology of Migrant Populations seeks, first, to improve understanding of the nature, extent and mechanisms of human adaptability to urban and industrialized environments by examining the changes in biological and behavioral characteristics associated with the movement of socioculturally and genetically defined populations from rural to intensely urban environments. Among the environmental changes that appear to be most important in this regard are:

(a) *decreased* physical activity; hunger; exposures to heat, cold, dehydration and zoonotic pathogens; constraints and reinforcement by kin and religious ties; means of self-help and self-employment;

(b) *increased* living-space congestion and noise stresses; confrontations with impersonal routines and authority; informational requirements; demands for space, time, and fine motor controls (work routines, traffic); sizes and roles of peer groups (gangs); exposures to behavioral deviance, especially thievery, prostitution, homosexuality, and narcotics addiction; exposures to venereal disease; and,

(c) altered exposures to toxic chemicals and allergens, and, also, changed patterns of mate-choice and fertility.

Second, the research effort seeks to extend the findings by investigating the effects of socio-cultural and biological variance in the source populations, by experimentally controlling selected variables (e.g., diet), and by examining counterflows (e.g., suburbanization).

Work on the ecology of migrant populations would clarify the broadest common denominator of human responses to industrialization. On the average, Americans move every five years; every member of the IBP organization is certainly a migrant. World-wide, at least a billion people have migrated since World War II. And, of course, migration is a base adaptive process for all animals. Yet rigorous bio-social studies of migrants are almost totally lacking.

Priority in the work has been placed upon source populations and receiving areas under high physical and socio-psychological stress: thus, Holmes County, Mississippi, appears to be the most economically deprived in the United States. Correspondingly, some areas of Holmes Countian residence in Chicago—Maywood, and the West End—have been foci of violent unrest. Consequently, the work now under way and in prospect has direct bearing on questions of physical and behavioral epidemiology (developmental failures, obesity, motor-vehicular accident rates, narcotics addiction, etc.). Its findings would contribute directly to the urgent searches for social justice and tranquility called for by the President's National Advisory Committee on Rural Poverty, and the Kerner report on civil disorders. Its methodology and findings could serve as a base for comparable studies in other areas with large migratory populations, e.g., Latin America. Finally, the development of training, services, and research programs in deprived communities can serve as a basis for associated programs seeking to break up chronic poverty and despair.

The intrinsic importance of fundamental studies on the ecology of migrant populations has been recognized by a variety of public figures, including the Vice-President of the United States. It has also been possible to develop considerable support from potentially affected communities, and a modest involvement by behavioral and bio-medical scientists. But funding has been a ghastly problem, because granting agencies, whether Federal, State, or private, fear the risks of pioneering work, and will not deviate from narrow missions and mechanical schedules. For these reasons, funding attempts to date have sought only those

absolute minimum sums needed to make a viable start. Even this has proved almost impossible, since the components of research and indispensable supporting services required belong, in part, to the responsibilities of diverse agencies, and are, in part, no one's concern.

Figure III presents data on two extreme budgetary levels—the absolute minimum and the optimal: $3.5 million, and $10 million for research, and $12 million and $20 million for supporting services, respectively. The minimum program deals with two migratory flows—Negroes from Mississippi to Illinois, and from Georgia to New York, as well as with one receiving area: Fairbanks, Alaska. Its scope in regard to content is also restricted, with the foci being childhood malnutrition and its effects, adolescent behavioral responses, and adult hypertension. Many needed areas of observation and experimentation such as those on house-interior micro-climates, pesticide exposures, driving aptitudes and accident rates, and population genetics are not included because interested granting agencies have yet to be identified. Moreover, the anticipated procedures have been simplified, particularly limiting, in this way, the possibility of documenting stressful events and their correlates, as opposed to time-determined observations alone.

Within the structure of the United States' contribution to the International Biological Program, the study of the ecology of migrant populations has relevance for both "Environment" and "Man." It is centrally concerned with the industrialized environment—the *anthroposere*, in Sargent and Shimkin's terminology—and with the complex bionomics of our human species therein. Figure I illustrates the concept of the anthroposere, including its similarities and contrasts with the structure and processes of the natural environment. In relation to "Man," migrant studies enter critically into short-term adaptive processes, underlying secondary changes in cognition, lifeways, reproductive behavior, food patterns, and other responses. Migration also enters into long-term adaptations characteristics of the history of the human species (see Figure II). Specifically, migrant populations are highly suitable for nutritional and population genetics research; in addition, they provide additional measures for the adaptability of environmentally specialized populations, e.g., urbanizing Eskimo and mountain Quechum migrants to Lima.

A systematic international effort on the ecology of migrant populations has yet to come into being, in large part because of the novelty and technical difficulty of this research. However, the coordination of the United States program with research in Israel, Yugoslavia, and Australia, and with planned efforts in Canada, is needed. Also desirable is U.S. participation in work on Latin American urbanization, a concept sponsored by the Pan-American Health Organization.

It must be stressed that work with human populations requires social machinery, in target communities, to develop contacts with and support from those to be studied. This is especially true in fluid groups of migrants. For this reason, service operations—especially those of the Office of Economic Opportunity—are indispensable components of the Program design. It should also be noted that observations of direct value to service operations can be readily incorporated into research. Nevertheless, the financial difficulties of the country's Anti-poverty Program are gravely endangering service operations on which our work is essentially satellited. In Holmes County, a very careful assessment of needs generated a request for a ten-percent budgetary increase for calendar 1968; instead, there was no funding at all for four months. This forced operational suspensions and lay-offs which the affected community could scarcely absorb. Some restorations are essential if program quality is to be maintained; additional cuts would eliminate an essential base for the program on the ecology of migrant populations.

This is not all: if physical examinations are undertaken, as planned, of selected migrant groups, an appreciable number of cases, e.g., operable cancers, requiring medical intervention are certain to be uncovered. No funds have yet been allocated to handle these ethically mandatory requirements. A minimum estimate for such needs (exclusive of optional treatments) in Holmes County alone is $100,000 annually; a possible site for such care is the health center at Tupelo, Mississippi.

Overall, the development of the Mississippi-Illinois project alone will need services aggregating about $1.5 million annually. Most of these are fortunately again operative via the O.E.O.; their continuity should be supported in the strongest way possible. Other proposed program components enjoy partial medical support (University of North Carolina USPHS), but have weak social frameworks. For these a service support of another $1.5 million annually would again

be needed. In all, our program, dealing as it does with impoverished people who have lived long decades in the shadows of terror and ill-treatment, can be realized only in the context of a *much larger* service effort—approximately by a factor of 3 to 1. (As the research efforts would increase, however, service costs would rise only slightly). This of course is true for clinical research generally: bed-pans as well as computers must be provided for.

In general, the gains from an absolute minimum to an optimal level of functioning are estimated as follows (for research funding alone):

$3.5 million—minimum viable;

$4.0 million—moderate inputs for micro-environmental and selected genetic studies;

$6.0 million—comprehensive studies for Mississippi-Illinois; Georgia-New York; Fairbanks; partial U.S. participation in Canadian, Yugoslavian and Israeli projects;

$8.0 million—in addition, a major flow study (priority to research on Southwestern U.S.-California movements); partial U.S. participation in Latin-American research on the ecology of migrants;

$10.0 million—in addition, two suburbanization studies (Polish-Americans in Chicago and suburbs; Jewish-Americans in the Bronx and northern New Jersey).

Within the parameters given in Figure III, time phases over the five-year period can be interpolated. However, with the great delays and difficulties that have been encountered, the initial 1967–72 framework is no longer adequate for that optimal design envisaged in the Program Statement for the Pheasant Run Conference of March 17–19, 1967.

To be candid, funding failures have discouraged many who have wished to participate, and are rapidly breeding cynicism among those in the target areas. Mr. Humphrey's expressed interest aroused great hopes last fall: today, a bitter evaluation can be heard:

"If you're white, you're all right!
If you're brown, stick aroun'.
If you're black—get back!"

The program on the Ecology of Migrant Populations, although in deep distress, can be swiftly revived by prompt and reliable funding. Its scientific merits as the sole component of the U.S. program dealing squarely with human adaptation to the industrialized environment are significant. Its importance in regard to urgent problems of national welfare and security is paramount.

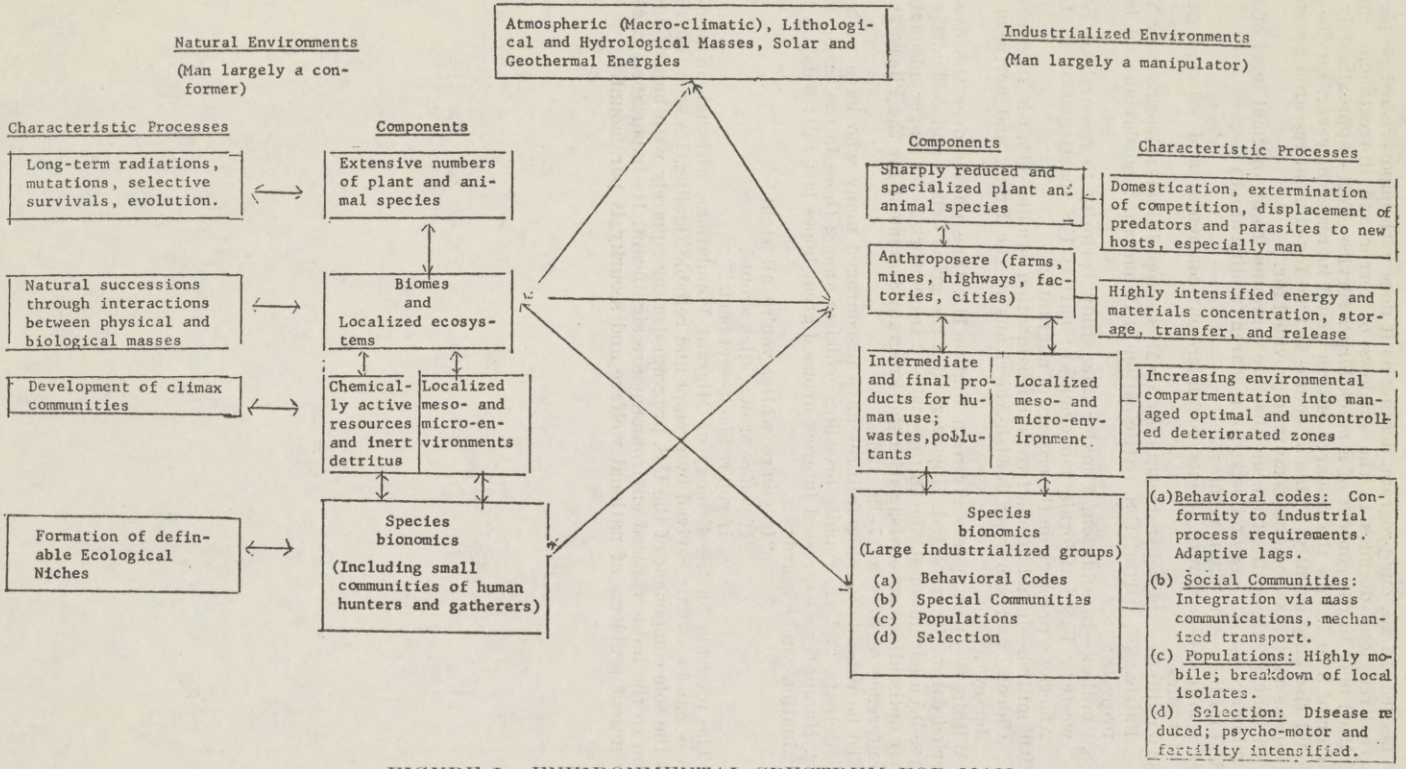


FIGURE I.—ENVIRONMENTAL SPECTRUM FOR MAN

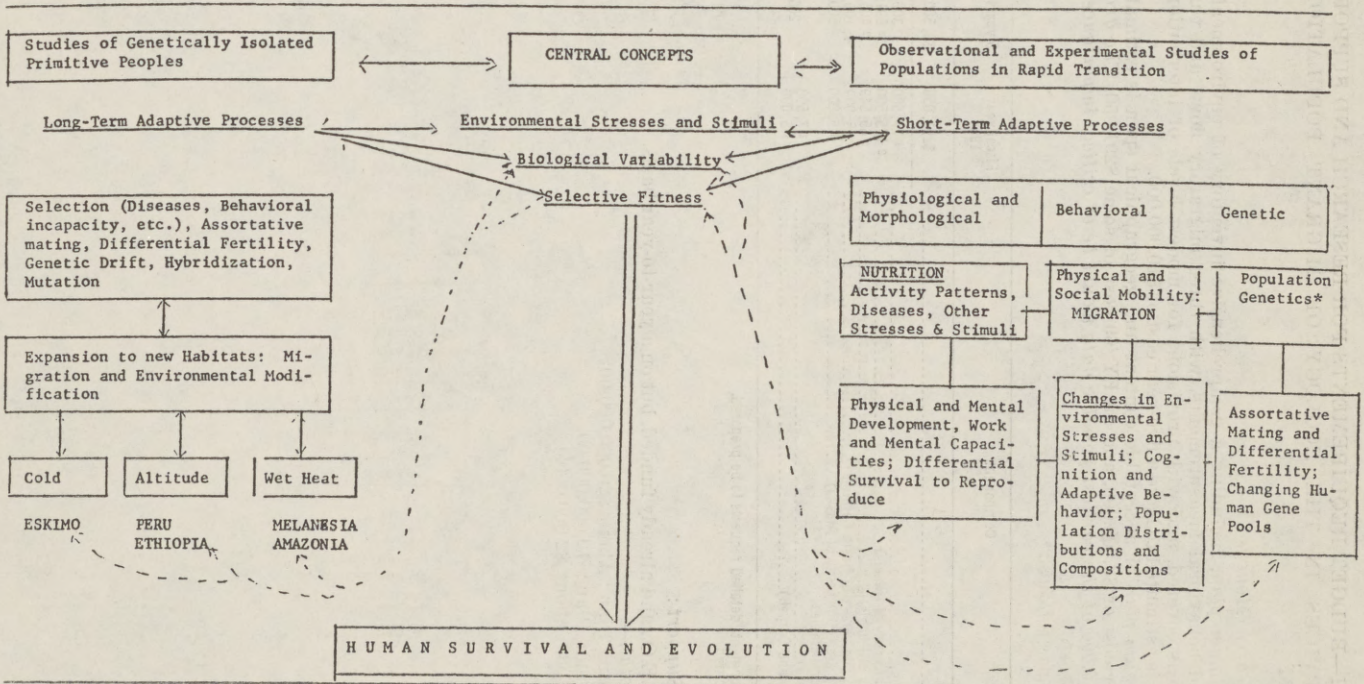


FIGURE II.—GENERAL MODEL OF HUMAN ADAPTABILITY CONCEPTS AND PROGRAM INTERRELATIONSHIPS

FIGURE III—BUDGET REQUIREMENTS FOR RESEARCH AND SUPPORTING SERVICES IN THE ECOLOGY OF MIGRANT POPULATIONS PROGRAM

A. *New Research Moneys*

1. *An optimum plan*, including a comprehensive inventory of environmental, physical, and behavioral measurements, with three migratory flows and three receiving areas covered, and with provisions for modest levels of international cooperation, is estimated to have a five-year cost of $10,000,000.

2. *A minimum plan* of acceptable content and geographical span is estimated at a five-year cost of $3,500,000, and an FY '69 cost of some $291,050. *The availability of $50,000 at the earliest possible date would be of critical importance to the entire effort.*

Details are as follows:

Component	Fiscal year 1969	5 years
Total	$291,050	$3,500,000
Central coordination	[1] 27,500	300,000
Holmes County (University of Illinois)	[2] 175,500	[2] 691,620
Chicago (University of Illinois)	[2] 65,549	[2] 405,879
Evans County, N.Y. (University of North Carolina)	[1] 5,000	1,100,000
Fairbanks receiving area (University of Alaska)	[1] 5,000	500,000
Supporting behavioral studies:		
(Louisiana State)	[1] 7,500	200,000
(Morgan State and Cornell)	[1] 5,000	

[1] Program development; detailed requests to be prepared.
[2] Requests submitted.

B. *Service Support*:

Largely O.E.O., and already funded, but on a year-to-year basis.

Five year total.—

Optimum Plan: About $20,000,000.00

Minimum Plan: 12,000,000.00.

(FY 1969, about $2,000,000.)

APPENDIX B

Biographies of Witnesses

Dr. W. Frank Blair, Professor of Zoology, University of Texas

Speciality: Population genetics and the ecology and speciation of mammals, reptiles and amphibians
Field of Speciality: Vertebrate biology
Born: June 25, 1912—Dayton, Texas
Married: 1933
B.S. (Zoology), University of Tulsa, 1934; M.S. (Biology) University of Florida, 1935; Ph. D. (Zoology), University of Michigan, 1939. Assistant, Division of Mammals, Museum of Zoology, University of Michigan, 1935–37; Research Associate, Laboratory of Vertebrate Biology, University of Michigan, 1937–46; Assistant Professor of Zoology, University of Texas, 1946–47; Associate Professor of Zoology, University of Texas, 1947–55; Professor of Zoology, University of Texas, 1955 on. Military service, 1943–46.
Publications: Dr. Blair has published extensively in his field of speciality
Societies: American Association for the Advancement of Science, American Institute of Biological Scientists, American Society of Ichthyologists and Herpetologists, American Society of Mammalogists, American Society of Naturalists, American Society of Zoologists, Australian Mammal Society, Ecological Society of America, Herpetologists League, Society for the Study of Evolution, Society of Systematic Zoology, Southwestern Association of Naturalists, Texas Academy of Science, Texas Herpetological Society.
Chairman of the U.S. National Committee for the International Biological Program, appointed January 1968.

Dr. Ivan L. Bennett, Jr., Deputy Director of the Office of Science and Technology

Dr. Ivan L. Bennett, Jr. was born in Washington, D.C. on March 4, 1922. In 1944, he married Martha Rhodes of Atlanta, Georgia; they have four children: Susan, Paul, Katherine, and Jeffrey.

Dr. Bennett was nominated by President Johnson to be Deputy Director of the Office of Science and Technology in the Executive Office of the President on July 30, 1966 and the Senate confirmed the nomination on August 31, 1966.

After receiving his A.B. degree in 1943 and his M.D. in 1946, both from Emory University, Dr. Bennett continued his postgraduate and residency training in internal medicine at Emory, Johns Hopkins, and Duke and was certified as a diplomate of the American Board of Internal Medicine in 1954. From 1947 to 1949, he was a guest investigator at the Naval Medical Research Institute in Bethesda.

After 2 years as Assistant Professor of Internal Medicine at Yale University, Dr. Bennett became Associate Professor of Medicine at Johns Hopkins in 1954 and, in 1957, he was made Professor of Medicine and Head of the Division of Biology and Oncology. In 1958 he became Baxley Professor of Pathology and Director of the Department of Pathology at Johns Hopkins University School of Medicine and Pathologist-in-Chief of the Johns Hopkins Hospital.

Dr. Bennett is a member of the editorial board of the *Bulletin of the Johns Hopkins Hospital, Experimental and Molecular Pathology, Laboratory Investigation,* and *Annual Review of Medicine.* He has been consultant to the Surgeon General of the Army, to the U.S. Public Health Service Communicable Disease Center, to the Office of Science and Technology, the Office of Emergency Plan-

ning, and to the Secretary of Health, Education, and Welfare. He was a member of the Commission on Epidemiological Survey of the Armed Forces Epidemiology Board from 1957 to 1966 and a member of the Pathology Training Committee of the National Institutes of Health in 1965–66. He has also served as Chairman of the Board of Scientific Councilors of the National Institute of Dental Research. Member of the Program-Project Committee of the National Institute for Allergy and Infectious Diseases, Chairman of the Pathology Test Committee of the National Board of Medical Examiners, and Member of the Committee on Influenza Research.

He is a member of the Board of Scientific Advisors of the Armed Forces Institute of Pathology, the National Board of Medical Examiners, and the Executive Committee of the Division of Medical Sciences of the National Research Council.

In April, 1966 he was appointed by President Johnson to the President's Science Advisory Committee.

Dr. Bennett has published about 120 scientific papers and is the editor of a textbook, "*Principles of Internal Medicine.*" He is a trustee of the Emory University Medical Alumni Association and is a member of several professional societies including the American Society for Clinical Investigation and the Association of American Physicians.

DR. LELAND JOHN HAWORTH, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Leland John Haworth became Director of the National Science Foundation on July 1, 1963, following Senate approval on May 9, 1963, of his nomination by President Kennedy. Dr. Haworth came to the Foundation from the Atomic Energy Commission where he had served as Commissioner since April, 1961. He succeeded Alan T. Waterman, NSF's Director since its establishment in 1950.

Dr. Haworth began his career as a high school teacher in Indianapolis, Indiana, in 1926–28 and then served as an Instructor in Physics at the University of Wisconsin, 1930–37. He was a Lalor Fellow in physical chemistry at the Massachusetts Institute of Technology, 1937–38. At the University of Illinois, he was an Associate, Assistant Professor, and Professor of Physics, 1938–47. From 1941–46, Dr. Haworth was on leave from Illinois working on defense projects at the M.I.T. Radiation Laboratory. He was appointed Assistant Director of Brookhaven National Laboratory in 1947 and Director of the Laboratory in 1948. In 1951, he was named Vice President and in 1960 President of Associated Universities, Inc., while continuing as Laboratory Director. From 1959–61, Dr. Haworth was a member of the Board of Directors of the Oak Ridge Institute for Nuclear Studies. He became a Member of the United States Atomic Energy Commission on April 17, 1961.

Dr. Haworth was born in Flint, Michigan on July 11, 1904. He received an A.B. in 1925 and an A.M. in 1926, both from the University of Indiana. He was awarded his doctorate in physics from the University of Wisconsin in 1931. Dr. Haworth was the recipient of D.Sc. degrees from Indiana University and Bucknell University and a D.Eng. degree from Stevens Institute of Technology in 1961. He was also awarded a D.Sc. by the University of Wisconsin in 1962. In 1964 Dr. Haworth received an honorary Doctor of Civil Laws from Union College, Schenectady, New York and a Doctor of Laws from Rider College, Trenton, New Jersey. Conferred on Dr. Haworth in 1965 were Doctor of Laws degrees by Long Island University and Delaware State College and D.Sc. degrees by Columbia University and the University of Illinois.

The list of special scientific committees and project groups that Dr. Haworth has served on include Project Vista, U.S. Army, 1961; the Ad Hoc Committee on Combat Developments, U.S. Army, 1954; Technological Capabilities Panel of the President's Science Advisory Committee, 1954; member and Chairman of the NSF Advisory Panel on High Energy Accelerators, 1954 to 1961; and Project Atlantis of the U.S. Navy, 1959. He was a member of the Board of Directors of the American Nuclear Society, 1955–60, and President, 1957–58. He is a Fellow of the American Physical Society, American Nuclear Society, the New York Academy of Sciences, and the American Academy of Arts and Sciences, Boston, Massachusetts. Dr. Haworth is also a member of the American Philosophical Society, National Academy of Sciences, Cosmos Club, Sigma Xi, Gamma Alpha, Phi Beta Kappa, Lambda Chi Alpha, and a Special Member of the Society of Naval Architects and Marine Engineers. He received a Certificate of Merit from the President of the United States for his World War II research. Dr. Haworth represents the Foundation of the Federal Council for Science and Technology, the Defense

Science Board of the Department of Defense, the Federal Council on the Arts and Humanities and the National Council of Marine Resources and Engineering Development. He is Chairman of the Committee on Academic Science and Engineering, a sub-committee of the Federal Council. Dr. Haworth also serves as a member of the President's Committee on Manpower and as a consultant to the President's Science Advisory Committee.

Scientific specialities in which Dr. Haworth has worked include the surface structure of metals, secondary electron emission, low temperature research, nuclear physics, high energy physics, very high energy accelerators, and electronics. He has written numerous scientific papers and is the author of several chapters of the M.I.T. Radiation Laboratory Technical Series.

Dr. and Mrs. Haworth, the former Irene Benik, reside at 2000 South Eads Street, Arlington, Virginia. Dr. Haworth has two children by his marriage to the late Barbara Mottier Haworth—Barbara Jane and John Paul Haworth. Barbara (Mrs. Charles Beck) resides in Alameda, Calif., and John Paul is a resident of Torrance, California.

DR. PHILIP HANDLER, JAMES B. DUKE PROFESSOR OF BIOCHEMISTRY, AND CHAIRMAN, BIOCHEMISTRY DEPARTMENT, DUKE UNIVERSITY MEDICAL CENTER

Born: New York City, 1917
Married: Lucille Marcus, 1939
Education: College of the City of New York, B.S., 1936, University of Illinois, Ph. D., 1939
Positions:
- 1937–39: Jr. Chemist, U.S. Regional Soybean Byproducts Lab.
- 1939–42: Fellow, Instructor, in Nutrition and Physiology, Duke University School of Medicine
- 1942–43: Assistant Professor of Physiology and Nutrition, Duke University School of Medicine
- 1945–50: Associate Professor of Biochemistry, Duke University School of Medicine
- 1950–61: Professor of Biochemistry and Chairman of Department, Duke University School of Medicine
- 1961: James B. Duke Professor of Biochemistry and Chairman of Department, Duke University School of Medicine

Publications:
- 200 research papers published in such professional journals as J. Biol. Chem., J. Am. Chem. Soc., J. Nutrition, Am. J. Physiol., Arch. Biochem. Biophys., etc.
- Co-author of "Principles of Biochemistry", 1954. Translated into Russian, Japanese and Spanish, now in third edition.

Memberships:
- National Academy of Sciences
- American Academy of Arts and Sciences, Fellow
- American Society of Biological Chemists
- New York Academy of Science, Fellow
- American Association for the Advancement of Science, Fellow
- American Chemical Society
- American Institute of Nutrition
- Society of Experimental Biology and Medicine
- Biochemical Society (Great Britain)
- American Society of Cell Biologists

Current Research Interests: Biological oxidations, mechanism of enzyme action evolution, amino acid metabolism.
Awards and Decorations:
- 1943: C. B. Mayer Award, New York Academy of Medicine
- 1964: Townsend Harris Medal, City College of New York
- 1965: Annual Orator, Pennsylvania State Medical Society
- 1966: Annual Orator, Cushing Society
- 1966: Henry Morgenthau Lecturer in Science, Hartwick College
- 1966: Sigma Xi National Lecturer

Activities:

American Association for the Advancement of Science
1962–65: Member, Committee on the National Program

American Association of Medical Colleges
1956: Organizing Committee for Institute on Teaching Biochemistry, Physiology and Pharmacology
1961: Organizing Committee for Institute on Role of Research in Medical Schools

American Institute of Biological Sciences
1960–63: Steering Committee, Biological Sciences Curriculum Study

American Institute of Nutrition
1959–62: Chairman, Award Committee, Osborne-Mendel Award

American Society of Biological Chemists, Inc.
1953–58: Secretary
1958–61: Counselor
1962–63: President
1964: Publications Committee

Brandeis University
1961–63: Member, Advisory Committee on Formation of a New Medical School

Citizen Witness for Budget of Department of Health, Education, and Welfare.
1956: Before appropriate House and Senate Committees

Cold Spring Harbor Laboratory for Quantitative Biology
1962–67: Member, Board of Trustees

Continental Baking Company
1960: Technical Consultant

Editor, Geriatrics; Advisory Board, Comparative Biochemistry and Physiology; Advisory Board, Journal of Theoretical Biology

Federation of American Societies for Experimental Biology
1953–66: Member of Board
1959–65: Member, Executive Committee of Board
1959–65: Chairman of Board and Federation

Foundation for the Advancement of Education in the Sciences, Inc.
1960: Member, Board of Trustees

Institute of Defense Analyses
1961–64: Member, Task Force 20

International Union of Biochemistry
1962: Chairman, International Meetings

Johns Hopkins University
1964: Member, Visiting Committee for Biology

Kettering Research Institute
1964: Member, Advisory Committee

Albert and Mary Lasker Foundation
1962: Member, Medical Research Awards Committee

Macy Foundation Conferences on Liver and on Metabolic Interrelations
1948–54: Member, Organizing Panel

Mead Johnson and Company
1957–65: Technical Consultant

National Academy of Sciences
1964–65: Chairman, Committee on Research in the Life Sciences

National Institutes of Health
1953–56: Member, Biochemistry Study Section
1956–58: Chairman, Biochemistry Study Section
1958–61: Member, National Advisory Health Council
1956–59: Member, Advisory Committee on Training Programs
1957–61: Chairman, Advisory Committee to National Institutes of Health and AEC on Radiation and Aging
1963: Member, National Advisory Committee Research Resources and Facilities

National Research Council
1950–53: Member, Panel on Metabolism, Committee on Growth

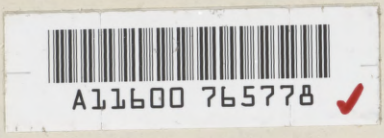
National Science Foundation
1958–60: Biological Research Facilities Panel
1960–62: Division Committee for Biology and Medicine
1962: National Science Board
1964–66: Vice-Chairman of Board
1966: Chairman of Board

Activities—Continued
Notre Dame University
1964: Member, Visiting Committee on the Life Sciences
Pennsylvania State University
1963–66: Member, Advisory Committee on Formation of a New Medical School
1964–65: President's Commission on Heart Disease, Cancer and Stroke
1964: President's Science Advisory Committee
Scripps Metabolic Clinic and Research Foundation
1963: Member, Advisory Committee
Society Experimental Biology and Medicine
1951–53: President, Southeastern Section
E. R. Squibb and Sons, Inc.
1966: Member of Board of Directors
Unitarian Service Committee and U.S. State Department Medical Mission to Japan
U.S. Public Health Service
1961–62: Member, Surgeon General's Committee on Environmental Health Problems
U.S. Veterans Administration
1951: Consultant

DR. HARVE J. CARLSON, DIVISION DIRECTOR OF BIOLOGICAL AND MEDICAL SCIENCES, NATIONAL SCIENCE FOUNDATION

Specialty: Bacteriology, Virology
Field of Specialty: ultraviolet irradiation; airborne organisms; oligiodynamics of metals; effects on bacteria and viruses; effect of chemical agents of poliomyelitis virus; research administration.
Born: June 10, 1911—Jerome, Idaho
Married: 1937
Children: 3
B.S., University of Washington, Seattle, Washington—1934, Fellow 1934–36; California, 1937; M.S.P.H., Michigan, 1940, D.P.H., 1943. Laboratory technician Idaho, State Department of Health, 1936–39; assistant bacteriologist, 1939–40; University of Michigan, 1940–41, research associate, 1941–42, instructor bacteriologist, 1942–43, assistant professor pediatric research, Western Reserve, 1946–51; biologist, Office of Naval Research, California, 1951–56, science liaison officer, England, 1956–58, Head Microbiologist, Branch 1958–59, U.S.N. 1944–46; Program Director, Facilities and Special Programs, National Science Foundation, 1959–60; Deputy Assistant Director for Biological and Medical Sciences, National Science Foundation, 1960–61; Division Director of Biological and Medical Sciences, National Science Foundation, 1961–present.
Societies: Society of Bacteriology; Society of Experimental Biology and Medicine; American Society of Microbiology; Academy of Microbiology.

○


A11600 765778