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BOARD ON SCIENCE AND TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT

Anniversary Report, Contract No. AID/csd-2584

1 April 1971 - 31 March 1972 (- 1975)

Introduction

During April 1, 1971, through March 31, 1972, the Board on Science and Technology for International Development of the National Academy of Sciences (BOSTID, NAS) has continued its bilateral workshops and joint study groups in collaboration with counterpart institutions in Latin America, Africa, and Asia. Departing from its usual bilateral format, it also undertook multilateral, or regional, workshops, one in Central America and one in Southeast Asia, on the interaction of economic development and environmental protection, with particular emphasis in the Asian workshop on water. The common theme indicates the developing countries' growing concern for environmental problems and their recognition of the need for regional cooperation.

BOSTID also continued work on special advisory studies requested by the U.S. Agency for International Development (USAID) and started a new study. BOSTID's special studies have grown in number and scope to the point that in the past two years the activities approached the volume of its bilateral programs abroad. The working titles of these studies show their diversity:

- Scientific and Technical Information for Developing Countries
- The Role of U.S. Engineering Schools in Technical Assistance Overseas

- Utilization of Solar Energy in Developing Countries
- Development of Research Administrators and Technical Managers in Newly Industrializing Countries
- Role of Multinational Corporations in Strengthening R, D & E in Developing Countries
- Appropriate Technologies for Developing Countries
- The Need for, Feasibility and Functions of an International Industrialization Institute (preliminary estimate)

Several of these studies have been undertaken in collaboration with the National Academy of Engineering, whose Foreign Secretary, Dr. Bruce Old, is chairing the last two.

In addition to these studies, addressed to particular problems for which AID has sought NAS assistance, BOSTID has also launched a wider-ranging study of "The Role of Science and Technology in International Development." This study will attempt to derive general principles and broad policy conclusions on the development effort in this decade and beyond, based on a careful examination of successes and failures in many cases of scientific and technological application to developmental problems around the world. This effort started in early 1971 and took form at a meeting at Woods Hole in August, 1971, attended by participants from the United States, Europe, several developing countries, and international development organizations. A first set of 15 case studies has been commissioned for completion this fall, when a second gathering is expected to take place. The final report, which is likely to consist of a synthesis and recommendations followed by a selection of the case studies, should be completed by mid-1973.

The Advisory Committee on Technological Innovation and Monitoring is taking another new, experimental approach. One key question in the socio-

economic development of many countries is whether there are new technological resources that will accelerate development, but developing countries are frequently unable to assess all the possibilities which involve the entire spectrum of technologies--the widely known high technologies and, in many ways more important, the low and middle technologies that are likely to have more impact on a country's development.

The Committee will attempt to generate information on and assess the validity of innovative applications of known technologies and new technological advances to immediate problems of developing countries and to identify areas of research where concerted effort can shorten the usual time required for scientific advances to progress from the laboratory to application in the field.

Finally, BOSTID is engaged in an analysis of its experience over the past 10 years in programs in science and technology and development. A study now being completed will synthesize its experiences and draw some generalizations about the conditions and techniques that optimize its efforts in the development field.

The Board on Science and Technology for International Development was chaired by Dr. Roger Revelle until March, 1972. Then, Dr. Carl Djerassi was appointed to succeed him as Chairman. In line with the restructuring of the National Research Council, and concurrent with this appointment, the decision was made to reorganize BOSTID. Because both overseas workshops and advisory studies have evolved from general considerations of policies for science in development to increasingly detailed sectoral policy questions, it was deemed essential that experts in specific sectors be available to help in planning, executing, and evaluating programs.

Thus, it was decided that small problem-oriented panels, with additional members selected on an ad hoc basis, will be BOSTID's working arm; and most members of the Board itself will be subpanel chairpersons. The full Board will meet probably once or twice a year to consider overall program direction and policy matters; the panels will meet as necessary to consider specific projects and programs.

The following report briefly summarizes all activities performed under contract AID/csd-2584 and attached task orders for the 1-year period ending March 31, 1972, as well as the remaining task orders still in effect under the former contract, AID/csd-1122.

Reports describing completed individual programs were either forwarded to appropriate AID offices or missions, or are currently in the final stages of preparation. A list of reports completed and in preparation is appended. Also attached are lists of NAS participants for each committee or panel.

The following task orders were issued, continued, or extended during this reporting period:

Task Order No. 1 provides for bilateral workshops and study groups with developing countries and for creation of advisory panels and special studies dealing with science and technology related to specific problems of development. (Effective dates: April 1, 1970 -- December 31, 1972)

Task Order No. 3 provides for the continuation of the Cooperative Science Program with the Argentine Council for Scientific and Technical Research. (Effective dates: August 15, 1970 - June 30, 1972)

Task Order No. 5 provides for the continuation of the NAS-COLCIENCIAS Cooperative Science Program with Colombia, involving study-group assessments of the potential for graduate education and research in Colombian universities. (Effective dates: November 15, 1970 - December 31, 1972)

Task Order No. 6 provided for a workshop with the Indonesian Institute of Science on the topic of industrial research as it relates to Indonesian economic development; the workshop took place in Djakarta, January 18 - 30, 1971. (Effective dates: November 23, 1970 - May 31, 1971)

Task Order No. 7 provides for the continuation of a study concerned with the assessment and evaluation of African Agricultural Research Capabilities. (Effective dates: February 10, 1971 - February 9, 1973)

Task Order No. 8 provided for a three-man study panel to visit Korea in January, 1972, to advise the Korean Ministry of Science and Technology on its long-range plans for policy and program development. (Effective dates: January 2, 1972 - March 2, 1972)

Task Order No. 9 provides for a joint study group on Demographic Training and Research in Zaire. (Effective dates: January 15 - December 31, 1972)

The Brazil and India science cooperation programs were continued under task orders to contract AID/csd-1122, the Board's former contract with AID, as follows:

Task Order No. 3 provides for a joint workshop with the National Research Council of Brazil (CNPq) on science and technology in development and the continuation of joint study groups. (Effective dates: February 1, 1968 - September 30, 1972)

Task Order No. 12 provided for collaborative workshops with the Indian National Science Academy. (Effective dates: January 23, 1970 - March 31, 1972).

BILATERAL PROGRAMS

LATIN AMERICA

Argentina

As part of the continuing U.S. - Argentine Cooperative Science Program, a Task Order was issued, effective August 15, 1970, to support implementation of recommendations adopted by the joint workshop of the NAS and the Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET) on Science and Technology in Economic Development (Mar del Plata, Argentina, July, 1969.)

Panels were formed to look into problems and opportunities in scientific information, groundwater hydrology, and food technology; and a series of projects and advisory missions were proposed.

This Task Order is in the process of being extended to December 31, 1972, to allow for the continuation of these activities. Accomplishments during the contractual period have been the following:

Science Information Programs

The Argentine Telex Network. The first Telex in the Argentine Telex Network was installed April 30, 1971, at CONICET; six of the eight national Argentine universities were linked to the Network during the period June - October, 1971. (Time lags were due to delays in equipment availability and installation by Empresa Nacional de Telecomunicaciones).

After Miss Monica Allmand, Telex Network Manager, completed her training program in the United States and Canada in February, 1971, she developed an operations manual (in Spanish), administrative procedures, and protocol for the benefit of Telex managers at the national universities.

John Crerar Library began providing photocopy/microcopy services to the Network in May, 1971. As the Network reached full operation, it became evident that these resources were not sufficient to meet the needs of the Argentines. An agreement with the National Agricultural Library, Beltsville, Maryland, was entered into in March, 1972, and negotiations are currently under way with other libraries. The Network also has access to the resources of the National Science Library of Canada, in Ottawa.

The Argentines have reported on the Network at a number of regional meetings in Latin America. Organizations in Brazil, Colombia, Mexico, and Uruguay indicated an interest in cooperating.

The Computer-Based Information Service. As originally envisaged, the project called for (1) a 1-year internship program at Chemical Abstracts Service (CAS), Columbus, Ohio, for the Argentine manager of the proposed service; (2) a U.S. consultant to help initiate the service in Argentina; and (3) commitment by CONICET of near- and long-term funding to establish the service.

In July, 1971, BOSTID and CONICET mutually agreed to a shorter, more intensive training program at the Computer Search Center at Illinois Institute of Technology Research Institute (IITRI), Chicago, as a suitable alternative to the CAS program. Decisions by CONICET on long-term funding of the service and selection of a trainee, anticipated during July - October, 1971, were not forthcoming. Discussions on the project between NAS, the IITRI representatives, and the Argentines tentatively scheduled for Buenos Aires in mid-November, 1971, were cancelled because of the lack of a specific agenda from the Argentines and other scheduling problems. Finally, in May, 1972, during discussions in Washington with Sr. Ricardo

Geitz, we were informed of CONICET's decision that for financial and organizational reasons, a major effort in the establishment of a computer-based chemical-information service was not feasible at that time. CONICET and EOSTID agreed, therefore, that the best alternative strategy for continuing joint activities in science information would be to expand and strengthen the Telex Network during the next 6 months by (1) supporting existing, and establishing new, links between U.S. libraries and the Argentine Network; (2) acquiring necessary bibliographic tools; and (3) undertaking a joint evaluation of the Network, to provide a case study for other groups contemplating similar activities.

Food Technology

A four-member NAS Panel on Food Technology met with eleven Argentine panelists designated by CONICET July 12 - 17, 1971, in Buenos Aires to review four concerns--manpower training, vegetable-protein concentrates, fish processing for human consumption, and dehydration of agricultural products. The discussions led to recommendations that emphasized needs for better integration of various studies of protein in Argentina; for sharing pilot-plant facilities; and, most urgently, for active industrial involvement in academic research programs. Recommendations for implementation were addressed principally to Argentine authorities; however, opportunities for collaborative research with U.S. universities were identified.

Bolivia

In response to an inquiry in November, 1971, from the President of the Bolivian National Academy of Sciences, concerning possibilities for joint programs with the NAS, a NAS staff member stopped in La Paz in

March, 1972, for discussions with USAID/La Paz and officials of the Bolivian Academy. Of particular interest to the Bolivian Academy is a systems study of the ecology of Lake Titicaca, a freshwater lake located at an average altitude of 3,800 meters. The lake plays a large role in the economy of the indigenous population of the Peruvian-Bolivian altiplano. Other activities of interest to the Bolivian Academy are studies of natural resources and manpower training, both in relation to national development priorities. Bolivian authorities have shown interest in a possible joint workshop and will make their recommendations to the MAS later in 1972.

Brazil

The major activity during this reporting period was the Fourth Brazil - U.S. Workshop on Science and Technology in Development jointly sponsored by the Conselho Nacional de Pesquisas (CNPq) and the MAS, in Washington, November 1 - 5, 1971. Objectives of the workshop were (a) to review joint study-group activities in agricultural research, agricultural economics, computer science, industrial research, and geosciences; (b) to review the operations of the Brazil - U.S. Chemistry Program since its inception in 1969 and discuss program plans for 1972 - 1974; and (c) to discuss future activities of the MAS and CNPq in scientific and technical areas of mutual concern.

Ten Brazilian scientists and engineers came to the United States to participate in the workshop with eight U.S. counterparts. Another ten persons from the U.S. scientific and technical community assisted in particular disciplinary areas during one or more of the workshop sessions. A summary of the major sessions and of study-group activities follows:

Chemistry. The operational activities of the chemistry program were reviewed in detail with the objective of solving problems related to the need for rapid importation of equipment and chemicals, and other administrative matters. A decision was reached not to expand the chemistry program by including additional Brazilian universities at this time; however, the field of catalysis research is to be added. The chemistry program will continue at least through 1974. Although this program resulted from a study group under the general cooperative program, AID financing of NAS participation is now accomplished through a host-country contract. Supplementary funding has been provided from both public and private sources.

Agricultural Research. Because the agricultural sector has been given highest priority in the Brazilian Development Plan, the CNPq is allocating more resources to agricultural research. In the NAS-CNPq program for 1972, studies of Brazilian agricultural education, agricultural research, and research activities in the cerrado (savanna) areas are recommended for consideration by the Joint Study Group for Agricultural Research.

Agricultural Economics. The joint study group has completed and sent to the CNPq for its review a proposed program for strengthening agricultural-economics research in state and federal agricultural stations. If accepted by the CNPq and the Ministry of Agriculture, the program would include cooperative activities between agricultural economists from U.S. and Brazilian universities, similar to the work of the chemistry program steering committee.

Industrial Research. The new Brazilian Development Plan emphasizes iron and steel production. Accordingly, the Joint Industrial Research Study Group is to assess facilities, manpower, and education-training programs in the areas of refractories, continuous casting techniques, and the basic-oxygen-furnace (BOF) steelmaking method.

Computer Sciences. The goal of the Joint Computer-Science Study Group is to recommend to CNPq a plan for developing computer-science education, particularly at the graduate level, that is suited to industrial and university needs in Brazil. At the Fourth Workshop in November, 1971, an interim report was presented. One month later (December, 1971), the joint study group met in Brazil to advance another step toward their goal. Visits were made to computer facilities and training centers in Rio de Janeiro, Sao Paulo, Belo Horizonte, and Brasilia. Specific recommendations have now been formulated which, if approved, would strengthen computer education in the universities and link computer users in universities and industries. It is expected that the joint study group will meet once more in Brazil in August, 1972, in conjunction with the Rio Symposium on Computer Education for Developing Countries, organized by the International Federation of Information Processing Societies and the Brazilian Information Processing Society. At the 1972 meeting, manpower data and other information will be available to permit the study group to make a definitive report to the CNPq.

Earth Sciences. Some Brazilian universities have begun new postgraduate programs in the earth sciences, directed mainly at problems of field geology rather than more fundamental aspects of mineral resources of Brazil (geophysical and geochemical questions). To strengthen indigenous capabil-

ities for the analysis of geoscience problems, additional postgraduate programs are needed, particularly teaching-research activities in geochemistry, geophysics, and mathematics applied to geology. It is the objective of the Joint Earth Sciences Study Group to develop plans and specific recommendations for such programs. The workshop received and approved a progress report for the study group dealing with these important scientific and educational problems.

Continuing Committee. Recognizing the importance of regular, joint consultations in the diverse fields in which CNPq and NAS are cooperating, the workshop called for establishment of a joint continuing committee which would meet at approximately 6-month intervals to attend to the operational and administrative coordination of programs.

Central America

A Central American Workshop on the Environment and Development, jointly sponsored by the NAS and the Central American Research Institute for Industry (ICAIII), was held in Antigua, Guatemala, July 25 - 30, 1971. Goals of the workshop were to stimulate an awareness among leaders in Central America of environmental factors in economic development and to lay the groundwork for concerted actions within the established framework of the Central American Common Market (CACM) countries (Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua). The principal focus of the workshop was upon the industrial, agricultural, and service-industry sectors. Papers on the human environment (population pressures), in planning at the regional level, and on consequences to education of environmental problems were also discussed. Thirteen of the eighteen

technical presentations were prepared by Central American organizations such as ICATTI, the General Secretariat for the Treaty on Economic Integration (SIECA), the Inter/American Institute of Agricultural Sciences (IIICA), the Central American Bank for Economic Integration (CABEI), and the universities. Participants came from each of the five Central American republics, as well as Mexico, Panama, the United States, and Venezuela. The workshop included a seminar on environment and economic development by representatives of the planning offices from the Central American countries.

Major conclusions and recommendations dealt with (a) the effects of rapid population growth and migration and the need for demographic studies, (b) the dearth of statistical data on human and natural resources and the need for more comparable statistical data among the Common Market countries, (c) the need for uniform industrial standards to promote development and minimize environmental degradation, (d) the urgent need to integrate common service functions by such means as international hydro-electric development and interconnection of national power grids, (e) the need for overall regional development of agriculture with uniform standards to conserve the environment, (f) the need to incorporate environmental concerns into the national planning processes in each country, (g) the recognition that training and research capabilities within Central America are required to deal with environmental problems and the need for universities and other existing organizations to provide these capabilities, and (h) the need for modern information systems and good dissemination of technical information on environmental problems. A report on the workshop entitled Conservacion del Medio Ambiente Fisico y el Desarrollo has been prepared and issued by ICATTI.

The workshop participants also recommended that an ICAITI-NAS committee be formed to give continuity to environmental programs in Central America and to stimulate appropriate action. During the coming year, it is expected that recommendations will be implemented, particularly those related to demographic studies and pesticide management in agricultural development.

Colombia

The closing of Colombian universities from mid-April through August, 1971, delayed the original schedule for studies of graduate education and research potential in Colombian universities. Therefore, the task order under which the Academy is working was extended to June 30, 1972. At the request of authorities in the Colombian Fund for Scientific Research (COLCIENCIAS), resumption of activities was further delayed until after the November - January university vacation period.

In planning the remaining studies (chemistry and mathematics were completed in February and March, 1971), a decision was made to combine engineering with physics and geology into one major study designated "engineering and applied sciences." COLCIENCIAS and NAS determined that this change in emphasis would more accurately reflect the real needs of Colombia at this time. An 11-member study panel from the United States went to Colombia for the period February 14 - 25, 1972. The study panel included specialists in civil, chemical, mechanical, and industrial-systems engineering, as well as electrical engineering - applied physics and mining engineering - applied geology. Members of the panel met in Bogota for general discussions with authorities of the Government of Colombia and then divided into disciplinary teams to visit 10 universities, several major industrial concerns, and the laboratories of the Industrial Institute

of Technology. The U.S. panelists were joined by Colombian counterparts during the visits and during the second week in Bogota when conclusions and recommendations were jointly formulated.

Because of the breadth of the study, recommendations for action were made both at the general level of engineering education and for specific disciplines. The report is to serve CCLCIENCIAS, the Colombian Institute of Higher Education Development (ICFES), and the National Planning Office in its ongoing efforts to strengthen educational opportunities and to develop manpower resources under the national development plan.

The similar Joint Study Group in the Biological Sciences was scheduled for the period May 30 - June 13, 1972, thereby completing the series of studies on Colombian graduate education and research potential in the sciences.

Peru

In 1966 and 1967 two bilateral workshops were held in Peru which have had considerable impact on science-policy planning. For example, the workshops stimulated the creation of the Peruvian National Research Council (NRC) and the Peruvian Association for the Advancement of Science. Then, during 1971, Peruvian scientists took the initiative to reestablish a program of joint activities with the NAS.

Dr. Antonio Bacigalupo, Acting President of the NRC, visited Washington in May, 1971, and met with NAS staff members to discuss Peruvian priorities in science and technology. At his request, an NAS staff member stopped over in Lima in July and met with Peruvian scientists to discuss the possibility of a joint study and to identify a specific problem area.

Widespread agreement was found for the timeliness of an analysis of national nutrition planning. A popular awareness of the problem of malnutrition exists, and the Peruvian government is coming to grips with the complexities of the situation through the development of a national nutrition plan.

The National Planning Institute (INP) is charged with drafting the national plan in nutrition and is actively seeking the participation of the MAS, to examine its work to date, with a private university in Lima--Cayetano Heredia University--acting as intermediary. An INP official proposed the following agenda:

1. The nutritional standards of Peruvians, including discussion of the measures used elsewhere to determine the nutritional state of the populace;
2. The human resources needed in governmental and other agencies to implement a national nutrition plan;
3. The teaching methods and curriculum for nutrition education at primary, secondary, and university levels;
4. The existing production and availability of foods, new food technologies, new food sources such as fish-protein concentrate and protein seeds and food supplements; and
5. The alternative strategies for implementing the national plan and a proposed governmental coordinating and executive agency.

It was anticipated that the workshop would be held in Lima for 1 week, probably May 22 - 26, 1972. Dr. Nevin Scrimshaw, Department of Nutrition and Food Science, Massachusetts Institute of Technology, and Chairman of the MAS-NRC (National Research Council) Committee on International Nutrition Programs, was to serve as the U.S. Panel Chairman. Unfortunately, due to complications on the Peruvian side, this workshop has been indefinitely postponed.

AFRICA

Ghana

In January, 1971, a bilateral workshop on "Research Priorities and Problems in the Execution of Research in Ghana," was held in Accra under the joint sponsorship of the U.S. National Academy of Sciences, the Council for Scientific and Industrial Research (CSIR) in Ghana, and the universities of Ghana.

The two specific recommendations that emerged from the workshop were to (1) establish a study group to consider the improvement and expansion of agricultural extension services, and (2) organize a group to investigate the creation of a science planning body for Ghana.

Agricultural Research and Extension

An analysis of the Ghanaian agricultural research situation pointed to the need for greater attention to the relationship between agricultural research and agricultural-extension programs and, in particular, to the development of a more coordinated system of training for and implementing agricultural extension.

The study on agricultural extension was formally begun in June, 1971, with a planning visit by the RAS co-chairman, Donald Barton. The three main objectives of the visit were to plan the terms of reference for the study; to meet with Ghanians responsible for implementing agricultural programs; and to agree on the best timing for the study, in terms of political, economic, and social considerations in Ghana.

The primary recommendations emanating from the study, which was held September 27 - October 8, 1971, are to (1) establish a "National Agricultural Service" administration within the Agricultural Ministry, which

would consist of the basic extension services with related activities; (2) separate the Ministry's Information and Publications Unit into two distinct entities, one to be retained by the Ministry as a public information unit, and the other--an agricultural-information extension unit--to be located in the CSIR; and (3) establish a mechanism for evaluating the effectiveness of agricultural extension in Ghana.

The recognition given to the study in Ghana was indicated by the extensive newspaper and television coverage at the opening session and the attendance of the Ghanaian Minister of Agriculture, the Chairman of the CSIR, the U.S. Ambassador and the USAID Mission Director.

As a by-product of the final exercise, discussions took place between individuals in cocoa research and the Hershey Corporation, which was seeking a means of improving its relationships in Ghana. These discussions may lead to expanded agricultural-extension activities in cocoa production utilizing professionals from the corporation.

It was planned that two members of the NAS group would visit Ghana again around May, 1972, to assess the planning and implementation of work in agricultural research and extension. However, these plans have been temporarily shelved because of the recent military coup.

Science Policy and Research Priorities

Planning for the study on science policy and research priorities was begun in October, 1971, during the visit to Ghana of the NAS co-chairman, Dr. George Hammond. Discussions were held with representatives of the CSIR; the Universities of Legon, Kumasi and Cape Coast; and many other individuals concerned with science policy and research priorities. The study, scheduled for March 7 - 23, 1972, in Accra, has also been postponed at the request of the Chairman of the CSIR because of the political situation.

Zaire (formerly Congo/Kinshasa)

A Workshop on Science and Technology in the Economic Development of Zaire during the 1970's was held in Kinshasa June 7 - 11, 1971, under the joint auspices of NAS and the Office National de la Recherche et du Développement (ONRD). The Panel spent 8 days in pre-workshop visits in the interior of Zaire. Most of the NAS panel and a number of Zairois scientists traveled together to the Katanga and Kivu Provinces to visit research institutes, training centers, a university, and other sites of interest. The NAS panelists found these visits very valuable as background for subsequent discussions of Zaire's needs to develop its scientific and technological potential.

The workshop, composed of 10 NAS panel members and about 30 Zairois scientists, technologists, educators, research administrators, and government officials, sought the following objectives:

1. To emphasize relationships between economic development and policies for investment in science and technology;
2. To consider policies to strengthen the capacity of the scientific and technical infrastructure to promote optimal development of natural resources;
3. To examine the capacity of research and extension facilities to promote Zairois agricultural development;
4. To examine the need for--and identify factors which might inhibit--the training of scientific and technical personnel required for development;
5. To identify and examine priority problems associated with food and nutrition in Zaire;
6. To identify a set of priorities for support of research and development during the 1970's;

7. To formulate a set of recommendations to strengthen a system for research-and-development supports; and

8. To formulate a strategy for implementing recommendations, including those requiring bilateral and multilateral technical collaboration.

The workshop participants agreed on recommendations for joint NAS-ONRD activity in five fields: science policy and economic development, natural resources, agricultural development, training of scientific and technical personnel, and food and nutrition.

The two institutions subsequently agreed to establish joint study groups in the areas of food and nutrition, demography, earth sciences; and to undertake a joint feasibility study on the creation of a primate research center. In the field of agricultural economics, discussions between the Zaire Ministry of Agriculture and the USAID Mission and a U.S. university have resulted in a project that will give the Ministry capabilities for economic research, and the Zaire National University the means to train a cadre of Zairois agricultural economists.

Demographic Training and Research in Zaire

The agenda and specific objectives of the Joint Study on Demographic Training and Research in Zaire were formulated in December, 1971, during the visit to Kinshasa of Dr. Ansley Coale, Director, Office of Population Research, Princeton University, and Chairman of the NAS panel. In collaboration with his counterparts, Dr. Coale identified two primary objectives of the exercise: development of plans for strengthening demographic data-gathering capabilities of the Government of Zaire and for establishment of a high-quality program in demography in the national university system.

The participants agreed on the need to obtain accurate demographic

data from a census process conforming to internationally recommended procedures as soon as the capability can be developed. The participants considered the existing mechanism--an administrative census--suitable for only certain governmental purposes but inadequate from the standpoint of demographic data needs. In the short term, a carefully done sample census of 5 - 10 percent of the population would provide information about fertility, mortality, and other fundamental aspects of the population, as well as serve to determine how complete the coverage of the administrative census is. Possible sources of external assistance from international agencies for census-taking activities were carefully considered.

Regarding the education of demographers, the joint study group unanimously agreed on a recommendation that a Department of Demography be established within the Faculty of Economics at the Kinshasa Campus of the National University. A draft plan already in existence for a demography department was examined and judged adequate. Detailed advice was given on the procurement of financial and human resources from several international agencies, such as the Population Council and the United Nations Fund for Population Activities.

Another important result of the study was the recognition of the need for close cooperation among the ministries and the ONRD in the design, data-collecting, and data-analysis of censuses. A specific recommendation was made to create a Higher Council of Statistics within the ONRD, which would perform these functions and distribute the information freely among government ministries and specialized agencies.

Earth Sciences

Dr. John C. Maxwell, Chairman of the HAS Division of Earth Sciences, made a preliminary visit to Zaire in December, 1971, to discuss with his

ONRD counterparts the scope, timing, objective, and panel membership of the study. Approximate meeting dates were selected and two priority issues for consideration were identified: the rehabilitation of Zaire's National Geological Survey and the strengthening of university and other programs for educating and training scientists and technicians in the earth sciences.

After Zaire's independence, the National Geological Survey lost most of its expatriate leadership and skilled manpower. The Survey's reactivation now awaits decisions on its appropriate functions and revision, and a solution to its manpower problem. The joint study group will examine the present and potential demands on Zaire's Geological Survey and focus on those in which it could be most effective, such as geological mapping, the evaluation of known mineral deposits, and geological engineering. The joint study group will also attempt to formulate a strategy to meet the Survey's immediate manpower requirements.

In regard to developing manpower for earth sciences, the joint study group will make a preliminary assessment of the present and future needs for earth scientists in the various sectors of Zaire's economy and examine ways to meet those needs: for example, through strengthening and expanding university programs, providing advanced training abroad, hiring short-term foreign personnel, etc. The panel is now scheduled to meet in Kinshasa July 20 - August 3, 1972.

ASIA

India

The NAS - Indian National Science Academy (INSA) Workshop on "Water in Man's Life in India" took place in New Delhi, September 13 - 17, 1971. The Indian participants--numbering variously up to some 80 persons--included leading union and state officials, scientists and technologists concerned with water-resources planning, utilization, and research. In addition, the Union Ministers for Science, Technology, and Economic Planning, and for Irrigation and Power, attended one or more sessions. The workshop received very extensive newspaper, radio, and television coverage. A month earlier about 120 scientists and technologists, gathered by INSA, met to establish a data base for the agenda discussion papers to be prepared by the Indian side. Documentation for the two events will be published by INSA.

The conclusions and recommendations of the workshop were addressed to: (1) the development of health-education extension systems in rural areas that are oriented to water use and maintenance of water quality; (2) the development of joint union-state management policy for water quality and quantity; (3) education of civil and sanitary engineers; (4) research on the economic implications of a safe, potable water supply for urban and rural populations, and the implications for economic development of water-pollution control and abatement.

Agreements had been reached with INSA for two major NAS-INSA activities in 1972: (1) a workshop in Washington in early 1972 on the organization, management, and operations of the NAS in its advisory role to government, for the benefit of the INSA leadership who wish to reorient

their Academy to similar ends; and (2) a workshop in late 1972 on "Technology and Development" to focus on problems of "technology policy" as distinguished from "science policy." However, due to the political situation and the current freeze on USAID assistance in India, the Academy's collaborative program is presently in abeyance.

Indonesia

As a result of the Indonesian - U.S. Industrial and Technological Research Workshop held in Djakarta in January, 1971, a program to improve the management and organization of industrial R & D institutes has been initiated by the Indonesians. Activities during 1971 included an intensive management development course in Indonesia and a 2-month visit to U.S. R & D institutes by two senior Indonesian R & D administrators. The Academy assisted in making the necessary arrangements with Denver Research Institute officials who conducted the program. This is an experimental program and will form the basis for a more extensive training program for Indonesian R & D managers.

BOSTID has been asked by the USAID Mission and the Indonesian Institute of Sciences (LIPI) to participate in another workshop to be held in Djakarta, September 11 - 16, 1972. The main purpose of this workshop will be to provide AID and the Indonesian authorities with recommendations on the management and planning of natural resources.

Korea

During January 10 - 22, 1972, the Academy organized a three-man advisory panel visit to Korea to advise officials of the Korean Ministry of Science and Technology (MOST). The team consisted of Dr. Roger Revelle,

Chairman, (Harvard University), Dr. Franklin Long (Cornell University), and Dr. Hubert Heffner (Stanford University).

The specific purposes of the panel were to (1) advise informally on the development of long-range policy for science and technology, (2) suggest ways in which the governmental structure for science and technology might be strengthened and improved; and (3) review the organization and functions of research and development institutions and suggest modifications where appropriate.

In carrying out its advisory mission, the Academy panel spent many hours in discussion with staff members of MOST and the Economic Planning Board, representatives of private industry, and economic and agricultural advisors of AID. Four separate meetings were held with the Minister of Science and Technology. In addition to interviews and discussions, the panel visited many of Korea's major research and educational institutions, including the Korea Institute of Science and Technology (KIST), Korea Advanced Institute of Science (KAIS), Korean Scientific and Technical Information Center (KORSTIC), Office of Atomic Energy Research Institute, Office of Rural Development and Agricultural Research Institute, National Industrial Research Institute (NIRI), College of Arts and Sciences of Seoul National University and the National Science Museum.

The comments and recommendations of the panel were reported orally to Minister Choi, other MOST officials, and members of the AID staff in Korea. Key areas of discussion included such topics as (1) the organization and activities of MOST, (2) problems of scientific and technical manpower, (3) the needs of science and technology in the universities, (4) research activities in agriculture and oceanography at specific

research institutions, (5) the problem of liaison between KOST and such autonomous institutions as KIST, KAIS, and OAE, and (6) the role of KOST in technological innovation, acquisition, and adaptation.

The staff director of the NAS Board on Science and Technology for International Development visited Korea 2 months after the advisory panel's trip to discuss possible follow-up activities. He learned from the Minister of Science and Technology that one of the key recommendations made by the panel, namely the establishment of a discretionary fund that will enable support for critical areas of scientific and technological development, was very likely to be implemented. When the formulation of strategy for implementing the Five-Year Plan for Science and Technology is completed in the near future, the Minister expects to seek further NAS cooperation on studies of specific, detailed areas of long-range scientific and technical activities. The Cabinet of the Korean Government will meet in April, 1972, to consider the full recommendations of the advisory panel.

Southeast Asia Regional

A regional workshop on Water Resources, Environment, and National Development was held in Singapore, March 13 - 17, 1972. The workshop, jointly sponsored by the Science Council of Singapore and the U.S. National Academy of Sciences, was attended by 20 delegates from six Southeast Asian countries--Singapore, Malaysia, Indonesia, Thailand, South Vietnam, and the Philippines--and 10 NAS participants. In addition, there were observers from several other countries, including Japan, Great Britain, and France. The private sector was well represented by technical and managerial personnel from a number of organizations, including such major companies as Shell and ESSO.

The principal objectives of the workshop were to (1) identify major problems concerning water resources and quality, and other areas of environmental concern among the countries of the region; (2) identify and explore available solutions to these problems and suggest actions required for developing new solutions and the capability for effective response to new problems; and (3) encourage and stimulate regional cooperation on problems of the environment.

One of the principal conclusions of the workshop was that there is no conflict between economic development and a healthy environment. The participants felt, on the contrary, that the region is facing a real opportunity to learn from the experience of other countries; by making wise decisions now and developing the appropriate kinds of information, manpower, policies, and legislation, the countries of Southeast Asia can protect their environment for a much smaller cost than later remedies for poor planning would entail. At the same time, the workshop recognized that many environmental problems now exist in the region that require urgent attention.

The three working groups presented more than 25 recommendations which were unanimously adopted at the final plenary session of the workshop. Principal among them was the need to establish a regional Environmental Control Organization. Underlying this recommendation was the understanding that the human and material resources for coping with environmental problems in the region are limited, that solutions to these problems may well require adaptation to local conditions, and that many of the environmental problems of the region are not confined by national boundaries and will demand cooperative action if they are to be resolved. A regional organ-

ization would be appropriate for a variety of activities such as training personnel, making contingency plans for environmental disasters, exchanging data and experiences, and arranging joint research efforts.

Two other conclusions were more general: The need for personnel is critical, because the number of scientific and technical personnel with qualifications for the necessary planning and action required by environmental problems is severely limited. There is also an urgent need for countries in the region to establish national agencies responsible for environmental-control activities and to give those agencies the highest level of authority and support.

Thailand

During the past year, several consultations have taken place between members of the Thai National Research Council and staff members of the Board on Science and Technology for International Development regarding the possibility of a cooperative program. As a result, a bilateral workshop is now scheduled for July 3 - 6, 1972, in Bangkok. Its purpose will be to formulate recommendations for developing Thailand's capabilities to plan and implement science policy. An eight-member IAS panel, led by Foreign Secretary Harrison Brown, will participate in the workshop.

SPECIAL STUDIES AND ADVISORY PANELS

The following studies have been completed or are underway during this reporting period:

Review and Evaluation of Past Activities with the Developing Countries

The main purpose of this staff study is to evaluate BOSTID's past activities in the developing countries in order to avoid past mistakes and to determine which actions were most significant.

Covering NAS programs in Africa, Asia and the Pacific, and Latin America from 1958 to 1971, the review will include, as well as the bilateral programs, the projects undertaken by regional boards and advisory committees before the change of emphasis to bilateral efforts. The report will have a summary of each NAS activity and an analysis of its impact in developing countries.

Scientific and Technical Information for Developing Countries

An ad hoc panel was established in February, 1971, to examine the problem of transferring scientific and technical information to developing countries, and to recommend appropriate forms of U.S. technical assistance in this area.

The panel, composed of information specialists and development experts from U.S. universities, government agencies, and private organizations, was aided in its deliberations by a number of individuals from other institutions in the United States and other aid-donor countries, as well as from regional and international organizations.

Specifically, the panel considered the requirements of developing countries for more effective acquisition and dissemination of information

in the fields of industrialization, natural-resources development, and the scientific and technical disciplines. It also identified various project alternatives and mechanisms that could be developed by AID to expand the flow of information to and among the developing countries.

The panel sought to provide a reasoned argument for the importance of systematic scientific and technical information-transfer within the total technical assistance effort. It stressed the need for much more activity and a higher priority in providing assistance in this field. Such assistance should aim at building and strengthening the developing countries' "information infrastructures," that is, information systems that are viable and responsive to changing needs, and that can continue to function effectively after AID assistance has ceased. Finally, the panel recommended that an administrative entity, with appropriate external advisory mechanisms, should be established within AID to plan and direct assistance in this area.

The panel's report was published in April.

Utilization of Solar Energy in Developing Countries

Rising interest in solar energy utilization, particularly in developing countries, prompted AID to request that an ad hoc panel be formed to provide AID with basic information and guidance on this subject. The VAS panel was composed of seven U.S. specialists, and one each from Canada, Australia, Niger, Israel, and India. The panel's terms of reference were to (1) assess the state-of-the-art in utilizing solar energy for different kinds of applications that would be useful in developing countries--including current practical applications; (2) identify promising

areas of research and development and indicate requirements for fostering efforts in such areas; and (3) assess the desirability of establishing an International Solar Energy Institute in North Africa.

The Panel's report and recommendations were transmitted to AID in March.

Development of Research Administrators and Technical Managers
in Newly Industrializing Countries

The ad hoc panel was constituted to advise AID on potential forms of U.S. technical assistance offering management training to administrators and senior researchers of industrial research institutes and other applied scientific establishments in developing countries. The objectives of the study were to (1) identify needs for, and features of, various training programs for research managers and senior researchers that U.S. organizations are best equipped to undertake in either the host country or in the United States; (2) assess the interest in such programs, and potential contributions towards them, of U.S. universities, government laboratories, private corporations, and independent research institutes; and (3) assess various alternative means of setting up training programs.

The draft of the panel's report and recommendations is now near completion. The final report is expected to be completed in August, 1972.

Role of Multinational Corporations in Strengthening R, D & E
in Developing Countries

NAS-LDC workshops in industrial research and other studies tend to indicate that U.S. firms operating in the developing world can contribute to the strengthening of indigenous research, engineering, and development

capabilities. To clarify these possibilities and provide guidance for its own policies, AID requested that a study be undertaken in collaboration with the National Academy of Engineering.

A panel was established to

1. Examine the past role of U.S. private investment in strengthening R, D & E capabilities of developing countries;
2. Examine the potential role of the U.S. corporation to assist in developing local R, D & E capabilities by
 - a. conducting local, in-house R, D & E programs;
 - b. identifying and designing R, D & E projects or processes of specific relevance to the host country;
 - c. adapting existing advanced technology to local conditions;
 - d. utilizing local R, D & E facilities and personnel; and
 - e. training research workers both locally and in U.S. laboratories.
3. Identify major factors that either strengthen or inhibit the initiation and expansion of these activities. This analysis should include such factors as the following:
 - a. management attitudes toward local development efforts and U.S. corporate responsibilities therein;
 - b. management policy on the decentralization of corporate R, D & E activities;
 - c. host-country policies toward technological development by foreign enterprises;
 - d. host-country import policies on scientific and technological equipment and materials;

e. U.S. and host-country fiscal incentives for undertaking R, D & E activities; and

f. U.S. and host-country patent policies and related measures to protect industrial property rights.

Ten of the panel members were from industry, two each from five sectors: automotive-farm implements, chemicals, electronics and communications, food, and pharmaceuticals. Five academic members were selected for their professional interest in the subject.

The panel met with ad hoc groups of experts from industry, the universities, foundations, government and international agencies in Washington, Boston, and New York. These consultation sessions provided a framework for the study.

The first draft of the panel's report is now being reviewed. The completed version is expected to be ready for transmittal to AID by September 1.

African Agricultural Research Capabilities

Agricultural development is of increasing concern to African nations, as well as to the United States, other donor countries, and international agencies. Promising results obtained through research in Africa, and other parts of the world, suggest the potential that exists for improving animal and crop production in Africa.

To explore this potential in depth, the Office of Technical Assistance Coordination in AID's Africa Bureau asked the Academy to undertake a study that would (1) review, analyze, and establish, if necessary, the priorities in research and education that will enable agriculture to make its maximum

contribution to the development goals of Africa; (2) specify the institutions and systems of agricultural research and research-related education--international, regional, and national--needed to achieve the goals identified in (1); (3) determine the most appropriate roles, modes of operation, subject areas, and locations for non-African agencies to provide coordinated support for agricultural research and education in Africa; (4) suggest appropriate channels of communication and cooperation among nations, agencies, and institutions; (5) outline the means by which research and education can be applied most effectively to agricultural development; and (6) make a broad assessment of the needs for scientific manpower implicit in the research system(s) and institutions recommended by the Academy committee.

To carry out this study, an international committee was created, consisting of 18 agricultural experts from the United States, Africa, and Western Europe. Several are affiliated with the leading institutions and agencies concerned with the development of African agriculture, such as the World Bank, FAO, the U.N. Economic Commission for Africa, the French and British aid programs, etc.

The first meeting was held in Washington, D.C., in April, 1971. A topical outline was drawn up to specify the subject areas to be addressed. Consultants were selected to provide resource papers on subjects such as commodities, livestock, farming systems, infrastructure of rural services and institutions, regional and international agriculture development, institutions and manpower training and others.

The second meeting was convened in Addis Ababa, Ethiopia, to afford study members the opportunity to converse with the 129 agricultural

scientists representing 20 African countries and 8 European and North American nations at the Conference of the Association for Advancement of Agricultural Sciences in Africa (AAASA).

Subsequently, two more meetings were held, one in Washington in December, 1971, and the other in Bellagio, Italy, in March, 1972, to review and discuss the deliberations and recommendations of the committee.

The final report is now being completed. After appropriate Academy reviews, it will be forwarded to AID.

This project has been carried out under the joint auspices of the NAS Agricultural Board and Board on Science and Technology for International Development.

Role of the U.S. Engineering Schools in Technical Assistance Overseas

Discussions between AID and NAS-RAE in 1970 revealed a common viewpoint that U.S. engineering schools should have a more active and relevant role in overseas technical assistance comparable to that of the schools of agriculture and experiment stations of U.S. land-grant universities. These discussions lead to the establishment of an advisory panel with the following objectives: (1) identify the interests and capabilities of U.S. engineering schools that are related to such needs of developing countries as curriculum reform, training and orientation of teachers, and development of indigenous institutions; (2) recommend needed changes in the curricula of U.S. engineering schools to train engineers more directly to work with problems of developing countries; (3) examine ways to relate research interests of U.S. schools to specific problems of developing countries and recommend ways in which AID can mobilize U.S. schools for this task; and (4) assess the interest of U.S. engineering

schools, and their capabilities, in acting as intermediate contract organizations in implementing development projects.

The panel's report, now in draft, will be ready in early fall.

The following studies, ongoing after March 31, 1972, were either started or continued during this reporting period.

The Need for, Feasibility and Functions of an International
Industrialization Institute (preliminary estimate)

Acting on a recommendation by the Airlie House Advisory Committee in December, 1971, AID requested NAS-NAE to assess the need, feasibility, viability, and demand for the services of an International Industrialization Institute to aid the developing countries in the industrialization process.

The proposed Institute's general objectives were envisaged tentatively as follows:

1. To gain a better understanding of the many factors that affect industrialization and the interaction between these factors;
2. To assist the industrialization efforts of developing countries by analysis and demonstrative action that clarifies and stimulates more effective use of technology appropriate to local conditions, with particular emphasis on involving the U.S. private sector in such assistance; and
3. To provide financial and technical support for projects undertaken by selected institutions in developing countries that offer particular promise to strengthen indigenous capabilities for industrialization and are consistent with the factor endowments of the country.

The NAS-NAE study was divided into two phases. Phase I was designed to furnish a preliminary assessment of the need and demand for the institute through in-depth interviews with knowledgeable persons in the United Nations, foundations, the World Bank and its affiliated organizations, development banks, and other international assistance agencies located in the United States. This material was considered at a two-day meeting of a specially appointed NAS-NAE panel, composed of U.S. and LDC specialists, which recommended that the study proceed to a full, NAS-NAE formal feasibility report. This phase of the study was completed April 1, 1972, with a two-day panel meeting of experienced people from the developing countries and U.S. organizations.

The panel concluded that there is a demonstrable need for an institute; therefore, the panel recommended that the study continue into Phase II. This phase is to structure the institute in some detail, with emphasis on management and organization, programs, staffing, and funding. It is expected that the study will be completed by October 30, 1972.

Appropriate Technologies for Developing Countries

Began in 1971 under the title, "Labor-Intensive Technologies for Developing Countries," this study was broadened in 1972 to include a wider range of topics that affect the industrialization process. The study now deals with labor-intensive versus capital-intensive techniques; strategies on import substitution, tariffs, and capital; managerial factors in production and marketing; and noneconomic factors in the technology-transfer process. With the assistance of the Overseas Development Council, a review paper was prepared, Economically Appropriate Techno-

logies for Developing Countries: A Survey. In February, 1972, an NAS-NAE ad hoc panel was convened with the following objectives:

1. To appraise the relationship between technology and employment in developing countries;
2. To determine means whereby developing countries can achieve indigenous capacity to select, adapt, and invent technologies appropriate to their needs;
3. To identify research needs that are relevant to adapting technology; and
4. To survey U.S. capabilities to help developing countries achieve these goals.

Because the task is so complex, the study of economically appropriate technologies is expected to continue through calendar-year 1972 along the following lines:

1. Organization of special task-force groups to examine ongoing experiments in adaptive technology in selected product-process areas-- for example, housing, road construction, small-scale chemical manufacture, agriculture technology, and small-scale mining and mineral technology; and
2. Convening a specialized panel to explore the economic alternatives in technology adaptation, from the viewpoint of national planning priorities.

In addition, several other areas that are related to appropriate technology development will be considered, such as managerial factors, skilled manpower requirements, and a "systems approach" to technology choices.

The Role of Science and Technology in International Development in the 1970's

During this reporting period plans were made, and a panel established for a study on "The Role of Science and Technology in International Development in the 1970's."

The broad objectives of the study are:

1. to identify the development problems that are most susceptible to scientific and technological solutions;
2. to recommend ways of helping developing countries to create or expand their own capability to utilize science and technology;
3. to consider contributions that the scientific and engineering communities of the industrialized countries are particularly qualified to make towards solving problems;
4. to identify new developments in science and technology that show promise for economic and social development; and
5. to formulate guidelines that will help administrators of technical-assistance organizations to utilize science and technology most effectively for coping with development problems of the next decade.

As a first step, a conference was held at the Summer Studies Center, Woods Hole, Massachusetts, from August 15-21, 1971. About 35 participants from Argentina, Uruguay, Mexico, Ghana, the Philippines, Canada, and England, as well as the United States, attended, along with several observers and Academy staff members. The group came from academic and research institutions, private industry, and a number of organizations active in development assistance, such as UNDP, UNIDO, OAS, IBRD, Canadian International Development Research Centre, and AID.

IAS President Philip Handler welcomed the participants at the

opening session. After 2 days of plenary sessions, the participants divided into three working groups to study (a) the capacity of developing countries to generate science and to generate or adapt technology, (b) the capacity of developing countries to utilize technologies effectively, and (c) the role of developed countries in helping the developing countries to use science and technology as effective instruments for development.

As a result of the conference, papers on specific issues are being commissioned; some are relevant to a wide range of developing countries; some use a case-study approach to illustrate both successes and failures in applying science and technology to the development of particular countries. The commissioned papers will be reviewed by a study committee, which will then be responsible for preparing a summary and developing appropriate conclusions and recommendations. The commissioned authors and study committee will be drawn from both developed and developing countries. The majority of the commissioned papers are now in progress and it is expected that a conference to discuss final drafts will be held near the end of 1972.

Innovative Potentials in Inexpensive Roofing Systems for Developing Countries

Problems of roofing constitute the greatest construction obstacle to the production of housing in the less developed tropical areas of the world. AID annually commits considerable sums of money for the construction of low-cost housing in less developed countries, a major part of which is for purchase of roofing materials. At the request of AID, the Board on Science and Technology for International Development is collaborating with the Building Research Advisory Board to explore the feasibility

of initiating, or stimulating, a program of research and development in this area and to outline a program should its feasibility be established.

The Building Research Advisory Board is organizing a 15-man advisory panel of designers, builders, market analysts, and building-material developers, including specialists from AID-recipient developing countries. The candidates for this advisory panel have been suggested by members of the Building Research Advisory Board, the Federal Construction Council, Building Research Institute, Building Industry Manufacturers Research Council, U.S. National Committee/Council for International Building Research and Documentation, and the U.S. Department of Housing and Urban Development.

The panel will meet twice, first to map out the exploratory effort and, second, to consolidate recommendations. The first meeting will be held April 19 - 20, 1972; the second is scheduled for late August, 1972. The recommendations will be presented to BOSTID for transmittal to AID and, if further in-depth research is feasible, the panel will outline the future steps that AID should take.

It is anticipated that this study will identify promising materials, material combinations, and areas of research, and that it will set guidelines for a more comprehensive, perhaps worldwide survey. The report will be intended for use by AID and other agencies, such as CARE and UNIDO, which are concerned with the construction of low-cost housing in tropical countries.

Technological Innovation and Monitoring Program

A key question in the economic and social development of many countries is whether there are new technological approaches that will accelerate development. Although developing countries are usually aware of the problems they face in achieving a faster rate of development, they often are not in the position to avail themselves of all the possibilities that technology can offer for solving these problems. These technologies may be latent; or they may be already utilized in the United States or other industrialized countries, but in a way that would not be suited to the social or economic conditions of developing countries.

To respond to this need for special technological innovation, an Advisory Committee on Technological Innovation and Monitoring was set up at the end of July, 1971, by the Board on Science and Technology for International Development at the request of the Agency for International Development.

The program supervised by this committee has two specific objectives:

1. The generation of ideas for innovative applications of present-day technological developments to immediate problems of developing countries; and

2. The identification of areas of research where concerted effort can drastically shorten the time lag characteristic of the normal progression of scientific advance to potential application.

The ideas and projects that the program fosters to achieve its objectives must be compatible with the following criteria:

1. They must have the potential to accelerate the development of one or more developing countries.

2. They must directly involve science or technology as the major component.
3. They must be beneficial in terms of human needs and values, and they should take account of local cultures.
4. They must not involve the exploitation of any country by another or of any class by another.
5. They must be innovative. (Consulting firms can better handle conventional technologies.)
6. They must not be projects that would, or could, otherwise be developed for proprietary interest by a profit-making group.
7. The solutions should be realistically implementable, and the proposals should include plans for implementation.

The committee and its staff have a number of endeavors currently under way:

Potential of Ferrocement for Boatbuilding and Other Construction

In many developing countries fish is considered one of the most important natural resources because of its contribution to the protein level of local diets. Often, however, because of a shortage of suitable fishing vessels, the potential fish catch is rarely realized.

A possible solution to this problem is a method for small-boat construction, using multiple layers of chicken wire impregnated with concrete, which is now gaining momentum in a number of countries in the developed world. This method may have promise for developing countries because it uses materials that are generally available, it requires no

high technology, and it produces boat hulls that are remarkably resistant to corrosion in tropical environments. The literature on these ferroce-ment boats suggests that they can be produced at a low cost and under very primitive conditions.

The advisory committee has initiated a study of the potential use of ferrocement technology in international development. The study will investigate the potential of ferrocement for both boat-building and other construction (silos, roofs, walls, pipes, etc.). The results of the study are intended for use by AID and will also be distributed to appropriate organizations and individuals in developing countries. Because of the intense interest already shown in the preliminary staff survey, the panel anticipates that its report will be of even greater interest to development agencies and responsible officials in developing countries.

As a result of a recommendation made at a meeting of the steering group in February, 1972, a consultant has been engaged to survey the state of engineering knowledge of ferrocement. A second meeting of the steering group will be held in May to evaluate the report. A 5-day meeting planned for August, 1972, at Airlie House will include representatives from industry and participants from developing countries.

Non-Food Uses of Unutilized Proteins

Since the end of World War II, many projects have been started to develop, manufacture, and distribute a variety of protein supplements to improve the nutritive value of deficient diets. These projects have been sponsored, conducted, or supervised by the United Nations, private

industries, single individuals, foundations, and foreign-aid agencies of governments, using a variety of funds as financial support and many products as starting materials. In spite of these considerable efforts, only a handful of the numerous high-protein, low-cost food products that were developed ever reached the people for whom the foods were originally intended, largely because production did not appear to be commercially profitable.

As a consequence of this situation and in view of the realization that many sources of protein remain completely unutilized, the Advisory Committee on Technological Innovation and Monitoring is investigating the possibility of using these protein sources in non-food products for which markets now exist.

An ad hoc panel of experts has been formed to assist the committee by exploring the feasibility or advisability of organizing a formal study of the problem.

The group will be concerned, among other things, with the following:

1. Manufacturing processes in which proteins are produced as byproducts and largely wasted, as, for example, in the utilization and processing of coconut, tobacco, and castor-oil seed;
2. Commercial processes for which specific proteins are required as chemical reactants or ingredients, an approach to be taken in the hope of matching known raw material requirements with known raw material sources, as in the formulation of foaming agents and stabilizers, packaging and building materials; and

3. Processes that require chemical compounds uniquely or abundantly present in proteins, such as certain amino acids that are needed for the manufacture of pharmaceuticals.

The panel met in February, 1972. They felt that a necessary first step was to collect information on the present uses and the present fates of proteins that do not appear in the food market. The group compiled a list of people and organizations to be canvassed for information. Further action awaits the result of these inquiries.

Electrical Power for Villages in Underdeveloped Countries

An inexpensive, reliable power supply for simple communications equipment, including television receivers designed with lower power requirements, is an important need for less developed countries. A particularly urgent need for a small, low-power generator suitable for use in remote villages has arisen in the Satellite Instructional Television program, based on a synchronous satellite to be launched in 1973 by NASA, with TV broadcast capabilities to cover all of India.

Contacts were initiated with key Indian personnel associated with the satellite project to determine status and requirements. Dr. B.S. Rao, Director of the Electronic Systems Division of the Indian Space Research Organization, has indicated that the problem has not been satisfactorily solved and that he would welcome formation of a task force of scientists and engineers to investigate and recommend innovative solutions.

The evidence at hand currently indicates that

1. There is an unsolved problem in supplying modest amounts of electrical power to remote villages in less developed countries for radio, television, and other communications apparatus.

2. Kerosene-driven, thermo-electric and hot-air engine generators are potentially capable of satisfying the requirements, although other methods, such as inexpensive solar conversion, are not ruled out.

On this basis, an ad hoc committee of experts will be formed to sift and refine the evidence at hand, explore the feasibility of organizing a more formal study of the problem and searching for innovative solutions.

Use of Larvicidal Techniques and Materials for Mosquito Control

Preliminary investigation by the committee's staff indicates that many entomologists feel that the time is ripe for a new look at mosquito control in terms of innovative techniques that are not being explored by agencies concerned with public health in developing countries. For example, both recent and earlier work indicates a potential use of garlic extract or algae extracts as larvicides, carnivorous aquatic plants as consumers of larvae, sticky-coated seeds to trap and drown larvae, and other methods of biological control.

The advisory committee, through its staff, formed an ad hoc panel of experts to counsel the committee on the value of further endeavors in this field and recommend the most effective course of action. The panel met on February 9, 1972, and discussed a host of problems in the control of insect-vector-borne diseases and selected topics for further detailed study. At the next meeting, papers prepared by panelists will be discussed and recommendations made for specific projects in mosquito control.

"102 Problems"

The organization and publication of a series of volumes of specific technological problems of interest to developing countries would be very useful and valuable from many points of view:

1. It would provide a series of compendia, in specific fields, of real problems of practical concern to developing nations which, as a source or research topics, could stimulate the interest and involvement of researchers and graduate students, both at home and abroad, in technical assistance.

2. It would serve as a filter mechanism for screening the ever increasing problems that are being brought to the attention of the committee and staff, and would provide a needed data base for the committee's activities.

3. It would provide a mechanism for diffusion of technological information to the scientific community and to the public.

4. It would serve as one mechanism to enable the IAS to become a catalyst in applying the technological abilities of the United States to problems of development.

5. By incorporating solutions and the names of their developers in subsequent issues, it would increase communication within the developing world, facilitate wider application of results, and discourage duplication of effort.

Fruitful fields to be covered and techniques for gathering suggestions have been considered. The first volume in the series will be "100 Problems in Food Science for Developing Countries."

Reports Completed under AID/csd-2584 during period April 1, 1971 - March 31, 1972

Task Order #1

1. Summary Minutes of Meetings of the Board on Science and Technology for International Development (October 21 - 22, 1971)
2. Report on The Central American Workshop on the Environment and Development, July 25 - 30, 1971. (staff summary)

Conservacion del Medio Ambiente Fisico y el Desarrollo, proceedings of the Central American Workshop on the Environment and Development, July 25 - 30, 1971, published by ICATTI.

3. Summary Report of Workshop on The Role of Science and Technology in The Economic Development of the Democratic Republic of the Congo during the 1970's, June 7 - 11, 1971. (staff summary)
4. Report of a Workshop on Research Priorities and Problems in the Execution of Research in Ghana, January 18 - 22, 1971. (staff summary)

Research Priorities and Problems in the Execution of Research in Ghana, Part I--Summary, and Part II--Full Report, proceedings of the Workshop on Research Priorities and Problems in the Execution of Research in Ghana, January 18 - 22, 1971, published by CSIR.

5. Report of the Joint U.S.A./Ghana Committee on Agricultural Extension and Research, September 27 - October 8, 1971, published by CSIR.

6. Solar Energy in Developing Countries: Perspectives and Prospects, March 1972.

7. NAS Advisory Committee on Technological Innovation and Monitoring, Progress Report to HRS-NEC Governing Board meeting of February 6, 1972, made available to AID for distribution to Missions for their information.

Task Order #3 (Argentina)

none submitted

Task Order #5 (Colombia)

1. Report of a COLCHIBOIAS - NAS Panel Study of Graduate Education and Research in Chemistry in Colombia, February 22 - 27, 1971.
2. Report of a COLCHIBOIAS - NAS Panel Study of Graduate Education and Research in Mathematics in Colombia, March 15 - 20, 1971.

Reports Completed, (cont'd)

Task Order #6 (Indonesia)

1. Summary Report of an Indonesia - U.S. Workshop on Industrial and Technological Research, January 25 - 30, 1971. (staff summary)

Task Order #7

none submitted

AID/csd-1122, Task Order #12 (India)

1. Summary Report of Workshop on "Water in Man's Life in India," September 13 - 17, 1971. (staff summary)

Reports in Preparation on Activities held during period April 1, 1971
March 31, 1972.

AID/csd-2584, Task Order #1

1. Summary Report of the Workshop on the Contribution of Science and Technology to Development, Santiago, Chile, January 11 - 15, 1971. (staff summary)*
2. Summary Report of a Regional Workshop on Water Resources, Environment, and National Development, Singapore, March 13 - 17, 1971. (staff summary)*
3. An Analytical Review of NAS Science Cooperation Programs with Developing Countries
4. Scientific and Technical Information for Developing Countries*
5. Involvement of U.S. Engineering Schools in Foreign Assistance Activities
6. Development of Research Administrators and Technical Managers in Newly Industrializing Countries
7. The Role of Multinational Corporations in Strengthening R, D & E in Developing Countries

Task Order #3 (Argentina)

1. Report of the Argentina - U.S. Panel on Scientific Information--summary report of activities during contract period.
2. Report of Argentine - U.S. Study Group on Food Technology, July 12 - 17, 1971.

Task Order #5 (Colombia)

1. Report of Colombia Graduate Study on Engineering and Applied Sciences, February 14 - 28, 1972.

Task Order #7

1. Report of the Committee on African Agricultural Research Capabilities

Task Order #9

1. Summary Report of Activities of the NAS Advisory Panel to the Ministry of Science and Technology, Republic of Korea, January 10 - 21, 1972.*

*Reports completed and transmitted since March 31, 1972.

Reports in Preparation, (cont'd)

Task Order #9

1. Report of the Joint NAS - ONRD Study Group on Demographic Training and Research in Zaire, January 24 - 28, 1972. (English*) (French version to follow)

AID/csd-1122, Task Order #3 (Brazil)

1. Recommendations for Improving Computer Science Education in Brazil, May 1972 Report of CNPq - NAS Joint Study Group on Computer Sciences. (Meeting held December 10 - 15, 1971)
2. Science and Brazilian Development: Report of the Fourth Workshop on Contributions of Science and Technology to Development, Washington, D.C. November 1 - 5, 1971.*

Note: The above two reports are to serve as the semiannual report on status of study group activities in Brazil for the period July - December, 1971.

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