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A Review of
"Report of the Working Group on
Pure and Applied Research"

by

BOSTID Colloquium

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Report of the Working Group on Pure and Applied Research

BOSTID Colloquium

OVERVIEW

The paper discusses the development of basic and applied science and technology research abilities in developing countries. Several problems and solutions are offered, although the paper is more of a discussion of the proceedings than a cohesive paper.

HIGHLIGHTS

Topic #1: How should the U.S. help to train students from strategically important and unimportant LDC's?

Criteria: U.S. universities and international training centers should be used.

Possible Solutions: Incentives should be planned for the Universities to help foreign students from developing nations to study and work.

Topic #2: On what basis can funding for such programs be justified to U.S. institutions?

Criteria: Education must be considered a "development tool" which means students who have received funding need to return to their countries.

Possible Solutions: Foreign students go back with a good attitude toward the U.S. in general. This is often reflected in lucrative contracts to U.S. firms. They may also act as an "effective pro-democracy and pro-science lobby in national affairs."

Topic #3: What incentives can the U.S. and the home country use to make sure students return home?

Criteria: Students must be able to "fit" into the academic or scientific community on their return.

Students must maintain their level of studies with new facilities, libraries ...

Possible Solutions: U.S. should offer more support than it currently does to international institutions such as the NAS Brazil chemistry, the NSF Seed program, the BOSTID research program, and the Third World Academy of Sciences.

Topic #4: What can be done to attract top scientists and Universities to work on the problems of the Third World rather than on those of industrialized countries?

Criteria: Professionals will need to see more prestige tied with success in developing countries than currently exists.

LDC's themselves must attach importance to these problems (e.g. the ozone layer, the greenhouse warming effect...)

Possible Solutions: The U.S. should support International research programs which provide an environment for scientists from developed and developing countries to work together on these problems.

AID should consider more institution building than it currently does, particularly in the scientific fields.

REPORT OF THE WORKING GROUP ON PURE AND APPLIED RESEARCH

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The working group was chaired by Professor Walter Rosenblith, former foreign secretary of the National Academy of Sciences. A list of participants is attached. Professor Rosenblith introduced the discussion by stating that the subject of basic and applied research is so all-encompassing that in effect, "nothing is ruled out," and the group must determine which are the important elements of the subject.

Basic and applied research are not discrete entities, but rather they form a continuum. They cannot be easily separated, and it would not be fruitful to try to do so in order to assign one without the other to the developing countries as somehow a more appropriate role for them.

However, in the developing countries as in the United States, research is intimately connected to the universities, and the role of the universities must be of the highest concern. Willingly or unwillingly, the U.S. universities have been thrust into a role vis-a-vis the developing countries, as the United States has become in effect the university of the world. There has been no official or coherent policy, and no incentives specifically planned for the universities, but the U.S. finds itself host to a large fraction of the Third World students who are seeking higher education outside their own countries. There are about a million expatriate students in the world. In U.S. universities, there are 350,000 foreign students, of which the overwhelming majority are from developing countries, including China. Forty percent of them are graduate students, primarily in engineering, management, and science. The other 60% are undergraduates, and in addition there are large numbers of postdoctoral fellows and visiting faculty.

It is important for us to understand better how the development process is coupled to the flow of students. It is easy to see the advantage that is accruing to the universities on the U.S. side. Many university departments in engineering and science are dependent upon these foreign students. They fill a large fraction of the places in the classroom, serve as low paid teaching and research assistants, and ultimately fill many faculty positions. Those who study in the U.S. are generally friendly to this country as well as, or as a result of, being better informed and knowledgeable when they return to their own countries, and they form a backbone of pro-American feeling among leaders of the Third World.

But many do not return, but stay to work in our universities, industries and research labs. Why does this happen, and is this necessarily a bad thing for the developing countries?

These students are educated at the frontier of science and technology, and many will no longer fit into the academic or scientific environments of their home countries. Most developing countries simply cannot absorb many Ph.D.s. People with masters degrees fare somewhat better, however, since they are more adaptable and less forged on the U.S. anvil. But some other countries, like the U.K., do not encourage students to remain after their degrees; there is no work for them and they return home. In the U.S. there is a general reluctance to enforce the expulsion laws, and professors often expend considerable effort to place their students in

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this country. Because of this, higher education in the U.S. is not necessarily considered by some governments as a development tool.

Other countries take a broader view. Emigrant scientists represent a resource that may be tapped periodically or mined at a later date. Many return periodically to their homeland, invest funds, or offer advice based on broad experience in advanced laboratories. There are organizations, like the International Society of African Scientists, which facilitate this process. China has had a traditional acceptance of encouraging overseas study despite the danger of "brain drain" with the philosophy "some will return now, others will return later." This policy is changing, however.

Similarly, some reports indicate that there are 2,000 Korean engineering faculty in the U.S., whom Korea is able to "mine" effectively. There is evidence that the benefit to the American side has also been substantial, since Korean students who return to their country in positions of authority often give lucrative contracts to U.S. firms or universities. These returnees also provide an effective pro-democracy and pro-science lobby in national affairs.

There are other, broader interests served by training of large numbers of developing country students in the U.S. or other advanced countries. For one thing, great scientists are rare events which may occur anywhere in the world. Their discoveries serve all of mankind when they are given an opportunity to reach their highest capacity, and it is in everyone's interest that they be nurtured. It is also in the broad interest of the United States to develop an indigenous scientific capability in all countries. Basic science provides a foundation for industrial development everywhere, and developing country prosperity benefits the U.S. in the

long run. But U.S. aid is skewed toward the strategic countries, almost ignoring those countries that need assistance the most. The workshop returned to this point later on.

The effective use of science and technology in development has been evident in the newly industrialized countries, or NICs. By and large they have followed a common path to development. They sent large numbers of students abroad and provided incentives for them to come back. They imported technology, improved the design, and adapted it to their own industrial capability and situation. With some protection in the home market, they were able to lower prices and compete effectively with the original technologies. Only when the industrial base was secure did they begin to emphasize basic research. The Japanese are the prototypic example of successful application of this strategy.

Why is it that most developing countries are unable to repeat this experience and profit from their returning scientists? In many developing countries, the science faculties are decades out of date, both in terms of equipment and facilities and in libraries and opportunities for scientists to maintain themselves at the forefront of their fields. They offer their researchers little time or opportunity to do frontier science.

It was observed that the U.S. also does not make maximum use of the potential application of science and technology to development. U.S. universities are at the forefront of our research efforts, but they are not used effectively in the foreign assistance program. There are few incentives for U.S. universities to get involved in development work. The "impedence mismatch" is so great that universities should get together, approach this problem cooperatively, and decide how they could be better used, what they want, and how to make it more "legitimate" for American

scientists to work on development problems. It is easier for American universities to justify working with the NICs where the mutual benefit is more apparent. The private sector also has a role in international training and research, especially in opportunities for post-docs.

Science has importance to development beyond the training of technologists. Many of the most serious problems affecting developing countries are unsolved. Such problems as malaria, child mortality, and low crop yields in tropical soils are unsolved at present, not only because few resources are devoted to them, but because the scientific bases of the problems are poorly understood. Yet most scientists work in advanced countries and most of their efforts are dedicated to industrialized country problems. The scientific communities of all countries mulst be mobilized in the effort to solve the problems of the Third World.

Three successful examples were noted. THe NAS Brazil chemistry program was an example of cooperation by scientists of both countries to raise the level of chemistry research in Brazil. The NSF SEED program provided an opportunity for collaboration between U.S. and developing country scientists. The BOSTID Research Program provided resources and technical assistance to Third World scientists working on their own problems in their own countries. All three have been phased out or abruptly cut. There are other cooperative mechanisms at work in agriculture, such as the CRSP programs, but not in most other fields.

The existence of stable international institutions which foster science development is likewise important. One example is the Third World Academy of Sciences. But although it headed by Nobel Prize winner Abdus Salam of Pakistan, it has had difficulty attracting the attention of Third

World governments, or for that matter advanced country governments, with the exception of Italy. The United States governent, through NSF, has no mechanism for interacting with the Third World Academy. There has been a fruitful collaboration with the National Research Council on strengthening of research in Africa. Another useful entity for fostering research and international cooperation is the United Nations University, with which there is also minimal U.S. interaction.

On the other hand there is a real mechanism and opportunity for international cooperation in which the developing countries may participate in the global scientific programs. The first international polar year was in the 1860s, and 40,000 scientists participated. The first international scientific union was the International Research Council, which was formed before World War I. After World War II, UNESCO was created, and ICSU became its principal consultant. ICSU now includes 20 unions and is recognized by 70 countries.

International research programs like the International Geophysical Year are a good way to involve and assist developing country scientists. The proposed human genome mapping program is another good opportunity for international cooperation. In the 1990s, the emphasis will be on "global change." Half a million scientists may be involved, and most work will require close cooperation among scientists in different countries. Problems like the hole in the ozone layer and the greenhouse warming of the globe affect all countries and peoples. Other problems that must be attacked on a global scale include species extinction and AIDS.

However, for understandable reasons, many developing countries do not award these problems high priority. They cannot take an active role and contribute what is necessary without adequate resources and an active

scientific community. On the other hand, for political reasons, they cannot be used as passive laboratories where foreign scientists can come to do their research. The dilemma will become acute as these international efforts develop, and action must be taken at an early date to prepare all countries to contribute to the scientific activities.

There are multinational centers for training Third World researchers. Foremost among them has been the International Center for Theoretical Physics in Trieste. It has played an active role and become a significant center of advanced research itself, with generous support of the Italian government. Four additional centers in different fields are planned, with continued support from the Italians. The Germans also have a major program to host developing country scientists in German laboratories.

Why does the United States government not do as much? In the past the U.S. helped create the IITs in India, and has cooperated with scientific institutions in Latin America. But now AID does little institution building, and almost none in the scientific field.

Global scientific problems, including development problems, should have the highest international priority. Perhaps the terms that are used have worn out their immediacy, and a new vocabulary should be employed to attract new support. Biodiversity should be called species extinction. Deforestation means soil loss and water shortages. Geosphere/biosphere should be called global change. Even the words "development" and "aid" have lost their urgency, and may need to be replaced.