FUNDAMENTAL RESEARCH IN DEVELOPING COUNTRIES

By Michael J. Moravesik

Dr. Moravesik of the Lawrence Radiation Laboratory, University of California, went to Pakistan as an IAEA visiting professor. He worked in theoretical nuclear physics at the Lahore Atomic Energy Centre from September 1962 until May 1963. In this article he gives some personal views which he developed as a result of his experience.

Technical assistance is today a widespread activity. Large numbers of persons with special qualifications in the applied sciences go to the developing countries to work on specific research and development projects, as do educationists on Fulbright or other programmes - usually to teach elementary or intermediate courses. But I believe that until now it has been rare for a person primarily interested in fundamental research to go to one of these countries to help build up advanced education and pure research work.

Having recently returned from such an assignment, and having found it a most stimulating and enlightening experience, I feel moved to urge strongly upon others who may be in a position to do so that they should seek similar experience themselves.

The first step is to show that advanced education and fundamental research are badly needed in the under-developed countries. This is not at all obvious. I know of several rather prominent physicists (including at least one Nobel prize-winner) who think that the fostering of advanced scientific education and fundamental research in these countries is premature by several decades. And indeed, why should a country whose agricultural methods are perhaps the same as they were 2000 years ago, whose industrial output is that of a medium-size Western city, whose social institutions are those of a former age - why should such a country concern itself now with fundamental research in the sciences?

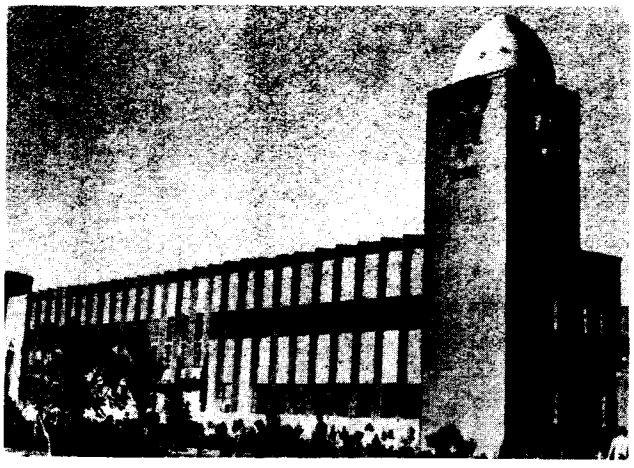
Reasons for Research

Let me therefore list some of the most important reasons why I believe basic research to be of the greatest importance, even today.

The urgent need for applied scientists who can do research related to the peculiar economic and technical problems of the country is seldom questioned. But the education of competent applied scientists must be done by people accustomed to go deeply into the fundamentals of science. This is because the fundamental science of today will become the applied science of tomorrow. The training of a prospective reactor engineer in the late 1930's or the education of a future transistor specialist in the late 1940's should have been done by people who have an intimate contact with the most modern branches of physics - i.e. by people who are themselves doing research in these fields. Otherwise the teachers will teach yesterday's science to tomorrow's scientists. This is a real problem in the developing countries, and I could point to many examples out of my own experience.

My second contention is that applied work can best be carried out if the researchers have constant access to people working in fundamental research. The training and experience of the latter tend to be both more thorough and broader (at least in the under-developed countries, where applied research is defined in the narrowest possible sense of the word), and he is educated to meet changes more easily. Thus the person working in fundamental fields can often serve as "idea man" to his applied colleagues by suggesting new approaches or analogies from other fields. This constant interplay between people doing fundamental and applied work is also widely practised in the advanced countries. The advantages are even more necessary to the under-developed countries, which face many more applied problems and under more difficult circumstances.

Few will contest that eventually every country should have its own scientific life in the fundamental branches of science. Granted this, my next point is that the development of a strong tradition in fundamental research takes a very long time - several scientific generations. Thus, while economic five-year plans are set up, a corresponding scientific fifty-year plan should be considered also. Part of this must be the fostering of pure research, perhaps on a small scale, starting today. The young scientists of today will be the heads of schools fifteen years from now, directing the initial efforts of those who in turn, another fifteen years later, will inspire those groups whose work will be comparable with that of the more advanced countries.



The Lahore Atomic Energy Centre.
(Photo. Pakistan A.E.C.)

There is a tremendous need in these developing countries for administrators with scientific background. Innumerable projects dealing with health, industrial processes, agricultural methods, etc. all need to be administered by people capable of understanding the technical aspects, in order to make intelligent decisions. It is my contention that the best training for the scientific side of such a job is a thorough training and working experience in fundamental sciences. I have seen several instances in under-developed countries where one brilliant and well-trained person is often enough to determine the pace of development in the whole country in a given field.

Achievement in fundamental science serves as a great encouragement and builder of morale, and high morale is one of the most important ingredients in the progress of a country. As an example, the name of Abdus Salam is widely known in Pakistan even by simple people little concerned with science, and his prominence is a shining example to young Pakistanis.

Assuming that I have made a case for fundamental research, it may be asked whether the developing country can afford it financially. My contention is that it can do so, on an appropriately modest scale. The advanced countries spend roughly one-thousandth of their gross national product on fundamental research, and I believe the same fraction could be spent by the developing countries, without undue strain.

Home or Foreign Training

I have tacitly assumed that advanced education should be carried out on the home soil. It may be asked why this is so, and whether the scientists of a country could not all be sent abroad for advanced training. There are several reasons.

Most of the developing countries have serious shortages of foreign exchange and cannot afford to spend it on training their people abroad, if this can be done at home. Training abroad is expensive in any case. Foreign fellowships can be relied upon only to a small extent, as such financial help is rather limited. Thus, beyond the very first stages of the country's development, when hundreds of scientists must receive education, scholarships do not suffice.

Western institutions of higher education are already overtaxed by demands from their own nationals, so that a candidate from another country, even if treated on the same footing as his Western colleagues, might well be rejected. This problem is becoming increasingly severe.

Scientific tradition is best built up by establishing a school in situ, where staff and students can work together, where the instrumentation problems and the technicians can be co-ordinated once and for all, and continuity established. When people are trained at widely varied institutions and then thrown into quite a different environment, the establishment of an effective research group is much more difficult. I have found this point very evident in visiting various research establishments in under-developed countries.

To live abroad and then return to the home country raises many problems of adjustment. Some trainees are never able to do their best in Western countries because of personal problems; others do well, but then get weaned away from their home country and are lost to it. Others again come home, but feel frustrated and out of place, as they would also feel if they had stayed in the West. These are all problems extraneous to science, and should therefore be avoided by providing higher educational and training opportunities on the home soil.

Having argued the case for fundamental research and advanced education in an under-developed country, let me show why such a country badly needs visiting experts who can spare a year or so of their time to join a basic research institute. What will he have to contribute?

He will bring with him up-to-date information on the state of science, new research methods and ideas, to break down the isolation which is one of the major handicaps of such an institution. A set of advanced lectures, some seminar talks, co-operation with local workers on specific research topics, can do a tremendous amount to stimulate and modernize the work of the institution.

A striking characteristic of the scientific life of the under-developed countries is that their personnel consists mostly of very young people, so that there is a crying need for group leaders, for originators of research, for "idea

men" who can guide the young graduates until they themselves, after five or ten years of experience, become scientific leaders. Thus a Western researcher with some experience in independent research can do wonders in making effective use of local talent, which might otherwise relapse into aimless stagnation.

A Western researcher, even if he has no special interest in scientific organization, is likely to have an implicit knowledge of how an advanced research institute operates, and this knowledge is badly needed. In matters of training, curriculum, library practices, organization of seminars, attraction of short-term foreign visitors (a particularly important aspect of the life of these institutions), the organization of preprint exchange, and many other matters, a Western expert can advise the local scientists.

In addition to all these more tangible activities, a Western visitor represents - much beyond his actual stature as a scientist - a note of encouragement and a source of high morale, which, as I have said, is of extreme significance. For instance, in the difficult matter of luring young graduates back from abroad, knowledge of the presence of a Western visitor might be a decisive factor. This form of recognition is very important to the success of these young institutions.

The Visiting Expert

Let us now look at the matter from the point of view of the visitor himself. What I advocate is that active research workers take a year off from their regular work, to spend it in this way. Would this not be too harmful for the scientific career of the person concerned?

My answer is that if he chooses the institution carefully, picks an appropriate time, and makes thoughtful preparations for the stay, such a venture is not merely not detrimental, but is even beneficial for his career.

The institution should contain workers of a certain minimum standard - that is, the nucleus of advanced work should already exist. This ensures the presence of a few interested and co-operative colleagues who are ready with criticism and can serve as a sounding board for ideas. The place should also have a certain minimum standard of physical accommodation - experimental equipment, desk space, library facilities - and of supporting staff. As regards libraries, the expert would do well to make sure that his usual preprints reached him at the new place, and he might also intensify his "private communications" for the year. Actually, the experimental equipment is usually not the most serious problem; money for

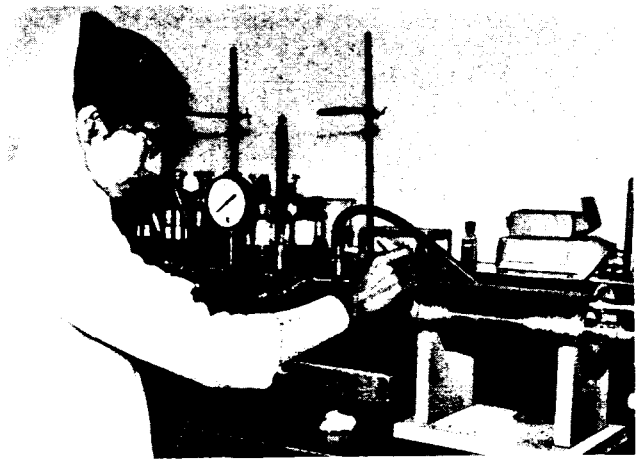
Group discussion on theoretical physics, with Professor Moravesik in the chair (Photo. Pakistan AEC)

equipment is usually more readily available than for any other purpose, and is easier to obtain than trained personnel.

The expert will have considerable time for his own personal research, and can work on some specific research problem, on which he has already done the initial spade work at his home institution. Such a stay also provides an opportunity for a theorist, or even an experimentalist, to work himself into a new field or to broaden his background in his own field. In the busiest centres of physics, one sometimes longs for a more quiet and peaceful time when one can do some systematic and extensive work to catch up with developments. I used part of my time for this purpose, and believe that I achieved more in Lahore than I would have in California.

How is such a visit to an under-developed country to be arranged? For somebody whose primary interest is research, financial help for such a visit is not nearly as well organized as it is for applied

Proportional counter designed and built at the Lahore Atomic Energy Centre. (Photo. Pakistan A.E.C.)



technical experts or for college educators. There are, however, several organizations interested in sponsoring such an undertaking. One is the International Atomic Energy Agency, which supports such experts at the request of the host government - thus in this case individual applications must be co-ordinated with requests from the recipient countries. The U. S. State Department and the U. S. National Science Foundation are also interested. University sabbatical years can of course also be used, and many of the more enlightened developing countries are quite willing to supplement such sabbatical salaries with allowances in their own currency, and perhaps also with free travel on the national airline.

Planning such a trip is, of course, somewhat more complicated than for a comparable trip to Europe, and correspondence and arrangements take longer. Thus it is not at all too early to start thinking about such a trip about a year and a half before the departure date.

Finally, the picture would not be complete if I did not mention the non-scientific benefits. For many of us, steeped in the academic atmosphere, it is an overwhelming experience to be confronted with the practical problems of foreign aid, world opinion, our image abroad, democracy versus strong men, and so on. To this is added the personal contact with cultures totally different from our own, and acquaintance with those who are trying to reconcile the two ways of life in their own personal conduct.

Let me reiterate that the purpose of this article is to convince some readers that if an active worker in fundamental research spends a year or two in an under-developed country co-operating in the development of basic science he performs a uniquely valuable service to the country involved. At the same time the stay will benefit him also, as a scientist and on the human level.