Science Policy & Planning

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A Seminar Discussion on

Science Policy & Planning

Guest Participant: Prof. Michael J. Moravscik

Chairman: R. O. B. Wijesekera

Organiser: Marina de Silva

Rapporteurs: Clodagh M. Fernando
Nimala Amarasuriya

Co-sponsors: National Science Council of Sri Lanka
United States Information Service.

The Seminar was inaugurated by **Professor P. P. G. L. Siriwardene,** Vice-Chancellor, University of Sri Lanka and held at the American Center, Colombo, on 21st and 22nd January 1976.

PROGRAMME

21 January 1976

Inaugural Remarks - Prof. P.P.G.L. Siriwardene

Session I - THE BASIS OF SCIENCE

Session II - SCIENCE EDUCATION; MANPOWER & RESEARCH

22 January 1976

Session III - COMMUNICATION, MANAGEMENT & PLANNING

Session IV - SYNTHESIS & PROPOSALS FOR THE LOCAL SCENE

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ORGANISER'S NOTE

The need to stimulate members of the scientific community into thinking about and involving themselves in Science Planning has been keenly felt at the National Science Council and the opportunity of having Prof. Michael J. Moravcsik, Professor of Physics and Director of the Institute of Theoretical Sciences of the University of Oregon, USA, lead a group discussion on aspects of Science Planning, was therefore welcomed.

Objectives

Primarily this Seminar was designed :

- to acquaint scientists and policy makers with the status of and methods in Science Policy activities. Special regard was to be paid to the problems of the less developed countries.
- to discuss controversial and open questions pertaining to the building of science in the less developed countries, and
- to survey the status of science development in Sri Lanka.

It was hoped that from this Seminar would emerge specific and practical proposals for the development of scientific activity in the local situation.

The emphasis of this Seminar was to be placed on "Science" rather than "Technology" as most discussions on "Science & Technology Policy" had upto now tended to centre on "Technology" rather than on "Science Planning". The functional and practical aspects of Science Policy, rather than formal or political pronouncements were to form the foci of discussion.

Participation

Participation at this Seminar was limited specifically to allow for informal discussion. Participants were selected to give as broad a spectrum of representation as possible and included science planners, and senior decision makers, science administrators, science educators and research scientists. Representations from both the natural and social sciences was sought, and younger scientists as well as the older scientists who had a longer involvement with science development were invited.

The proposal that the National Science Council sponsors this Seminar arose as an outcome of personal communications between the Organiser and Prof. Michael J. Moravcsik. This proposal which had the approval of the Secretary-General was subsequently sanctioned by the Council and the Ministry of Defence and Foreign Affairs.

This programme was made possible by the cooperation offered by the United States Information Service, which met Prof. Moravcsik's travel and per diem expenses.

Special thanks to Miss Diane Captain and Mrs. Margaret Gooneratne of the United States Information Service, who gave generously of their time and assistance. Thanks are also due to Mr. A.L. Jayewardena and Mr. K. Ratnasingham of the CISIR, members of the staff of the National Science Council and very specially to Miss Merlyn Silva of the National Science Council for all secretarial and other assistance.

Mrs. Marina de Silva
<u>Organiser</u>

INTRODUCTION

Chairman : Dr. R.O.B. Wijesekera, Acting Secretary-General

Science Policy is a topic that is now fairly widely discussed and yet it is not too easy to define precisely. Lord Todd has defined it as - "National Policy for the promotion of Science and Technology on the one hand, and for their application to promote desirable material and social change on the other".

This definition recognises the two facets of Science Policy. First' that of a policy to develop an indigenous scientific capability within a country; and secondly, a policy to utilise science for the purpose of fulfilling the goals and aspirations circumscribed by national policies for development. It must be noted that in consideration of Science Policy, "science" includes pure science, applied sciences and technology. The present Seminar is the first of its kind in Sri Lanka, where a group of scientists will hopefully discuss some of the problems connected with Science Policy that pertain to the development of a national scientific capability.

Professore Michael Moravcsik has been kind enough to accept our invitation to visit Sri Lanka to lead this Seminar - discussion and give us the benefit of his wide experience and knowledge of other developing countries of the world. It must be emphasised that Professor Moravcsik is a practising scientist being Director of the Institute of Theoretical Science of the University of Oregon.

So he would be most acceptable to working scientists such as many of us are. In addition, he is the author of a book on "Science Development" and over thirty five original papers in the Science Policy area.

Professor Moravcsik has also taken part in several seminars such as the present one in other developing countries.

I shall now request Professor P.P.G.L. Siriwardena, Vice Chancellor of the University of Sri Lanka and a fellow scientist himself to inaugurate this Seminar with a brief address.

INAUGURAL REMARKS

Professor P.P.G.L. Siriwardena

Vice-Chancellor, University of Sri Lanka

Let me thank the National Science Council of Sri Lanka for the invitation to deliver these inaugural remarks. It is a pleasant and honourable duty to be able to speak at the opening of a Seminar so vital to our country, in fact, to all developing countries like ours; we all recognise the role of science in the economic progress of nations. Rapid strides in industrial development can be directly attributed to the corresponding measures in scientific output. Yet, science depends for its progress on the input in terms of scientific and technical manpower and the finances to sponsor research and development projects. In a country which has limited resources in material, in skilled manpower and in finances a national science policy based on carefully considered guide-lines and proper planning with maximum use of the limited resources and capable of adjustment to changing conditions becomes all the more essential

The need for 'planning for science' was recognised in this country many years ago when the Ceylon Association for the Advancement of Science drew the attention of the Government of the need for a coherent policy for technology. The National Science Council was established by an Act of Parliament in 1968 with wide terms including the formulation of a Policy for Science and Technology in Sri Lanka.

Sri Lanka has embarked on many development schemes and these are laying the foundation on which more comprehensive plans are to be based. Science planning has to consider as an integral part, the teaching of science at school and university levels. Facilities for science teaching are being expanded and the curricula in schools have already seen change to give children a more meaningful training, useful both to them and to the country. The new courses do not cater only to those who will receive a university education but also to the large majority who will not do so, but will require to find other avenues of employment and interests. It has to be recognised that Sri Lanka's future development will depend to a very large extent on the scientist and it is gratifying to note that the steps taken for the creation of a unified scientific service is vital towards such recognition. The main targets of a development programme include priority of developing the infrastructure sectors of the country's economy, the raising of educational facilities and the improvement of the agricultural and industrial economy.

The development of science planning also requires raising the level of science education to the entire population -- the popularisation of science in a planned way through the various media. The Ceylon Association for the Advancement of Science is engaged in such activity and in a country where literacy is relatively high, many other organizations can pursue this activity with advantage. Science planning has the need to organize the scientists into a coherent force, make individual scientists feel that they belong to a scientific community which is a part of the social community.

Science and its applications develop only if the public at large too appreciate its importance and is receptive to new ideas. This type of public awareness is also a necessary pre-condition to investing reasonable amounts of funds for science development and research.

In a country where education has been taken to the entire population, the question of language too becomes important and this has necessitated teaching in Sinhala and Tamil. This and the need for an adequate knowledge of English in gaining knowledge in science are factors that have to be considered. The question of documentation, the need for communicating information, research and other scientific publications, the organization of seminars and symposia are also connected with scientific development in a country. Emphasis on research, research relevant to a country's needs, the co-ordination of research effort are matters this Seminar will no doubt consider.

Developing countries like ours have many difficulties in implementing their policies. Problems requiring immediate solution often take up so much time and energy of governments and administrators that the importance of science and hence of scientists for national development is not sufficiently appreciated.

This Seminar will also be aware of the small percentage of funds set aside for research; it is aware of the need for group research; the need for pulling out the young scientists and researchers into responsible activity and position. One might consider diverting a suitable proport proportion of industrial profits into science and research. Industrial profits depend on the ability of scientific personnel whose ability has to be maintained at a high standard.

Countries like ours have difficulties of foreign exchange, of obtaining equipment, books, journals. We are concerned with the brain drain. By stream-lining the choice of problems for investigation, we could make better use of our available capital and material, human and financial resources. Having evaluated our requirements in the correct order of priorities, we can find better use for funds both from internal and external sources.

In these random remarks one can also include international links, regional co-operation and the fact that science is international. A science policy is essential to ensure that the creative talent of the population is encouraged and finds full scope in scientific activity. It should make a better nation with a population with self-reliance.

I will conclude with the comment that these remarks have been made at random and as the subject is a wide one, I must confess that elaboration of many of the points has not been possible. I have no doubt that this Seminar will discuss many of these matters in detail.

I wish you every success for a very fruitful Seminar on a very important topic.

SESSION I - BASIS OF SCIENCE

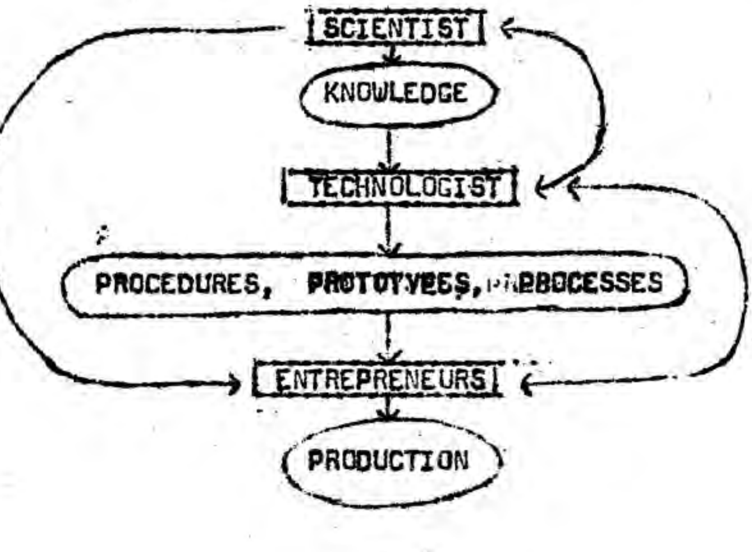
Professor Michael J. Moravcsik

I am interested in this opportunity to discuss with scientists in Sri Lanka the problems and the particular solutions which have been evolved here. Development problems differ from country to country due to geographical, economic, agricultural, industrial, historical and cultural differences and it is difficult to generalize. In the area of science development, however, problems are similar all over the world and it is possible to apply solutions found in one country to another. One good reason for this is that science is universal.

Generally, by a Science Policy is meant a science and technology policy and sometimes more a technology policy. I would like to emphasise the science aspect which is neglected very much and the distinction, as well as the relationship between the two which is not clearly articulated. This leads either to false expectations and over-estimations of output on the one hand or little or no understanding resulting in lack of keenese in supporting science.

Some useful working definitions are the following :

Science - pure and applied - is an activity to gather new knowledge about nature and things around us. The purpose of science is to generate understanding of nature and its product is new knowledge. In contrast, technology takes empirical knowledge and builds it into something new; prototypes, gadgetary procedures, processes - these are the products of technology. The whole chain can be represented diagramatically, thus :-



One of the functions of science is to increase the material standard of living. If this does not in fact happen, we should try to identify where there is a break in the chain or a bottleneck due to due .. inefficiency. The situation is rather complicated - it is not a case of putting in a sum of rupees at the beginning of the chain and getting an output of so many rupees at the other end.

Why Science ?

Why is it important to discuss what the basis of science is in a country particularly in Sri Lanka. A lot of people will question "why science ?" and an articulate answer is necessary to convince government bureaucrats, newspapermen and other laymen. Some, though not all of the effects of Science are long-range(about 3 to 4 decades) and we must have a long-range point of view and think ahead when we discuss the problems relevant to Sri Lanka. It takes decades to build up a sufficiently large scientific community, tradition and the institutional base for science. Two examples are USA and Japan. In the USA, at the end of the nineteenth century and even at the beginning of the twentieth century, science did not occupy important place. Centres of activity in all the natural sciences were located in Western Europe - Germany, France and England. After 1910, American scientists educated in German and Western European universities returned to America and started scientific research on a very inconspicuous scale. It was only during the Second World War that there was an exodus of scientists from Western Europe to America and they were instrumental in developing science in America to a large extent. The war itself stimulated and intensified scientific effort. Even then, it took the USA about 30 to 40 years to reach the position of a leading scientific nation. The other country is Japan whose experience is perhaps more relevant because it is sometimes argued that modern science is a typical European tradition and is difficult to transplant elsewhere. Japan upto 1870 was closed to any non-Japanese influence. From then onwards, scientific manpower developed through several decades. The first generation trained in Europe (mainly Germany and France) returned to Japam and produced the second generation which in turn trained a third generation locally in much large numbers. It was only by 1940 that Japan had the scientific infrastructure to occupy a place as an equal partner in international science. For this reason we have to think right now in terms of producing a sufficiently large and productive indigenous science community in Sri Lanka, say in 2010. But human nature is such that the immediately pressing problems get more attention while long-range problems get pushed into the background.

Justification for Science

Most of the things which are interesting and worthwhile have a variety of justifications. Things which have only one justification tend to be narrow and limited. Sometimes, however, a complex array of justifications is suspected and people feel that one important justification is preferable and more appealing in its simplicity. But I believe that different people respond to different justifications and there is nothing sinister or Machiavellian about using the most appropriate one for the occasion. There are three main justifications for science.

1. Science as a basis of technology
2. Science as a human aspiration
3. Science as an influence on man's world view

1. Science as a Basis of Technology

The first justification is the best known and most often talked about. Technology is in fact older than Science. Upto about hundred years ago, much of technology was not science-based, but evolved by trial and error by empirical experimentation and it was confined to that part of science which was within our everyday experience, e.g. heat and mechanics. It was only in the last hundred years that technology was based on that part of science, which was outside everyday experience such as electricity and its uses, power stations, etc. Now virtually all technology is based on science and in the future it will become more so.

How it works is a very complicated question. The time element is difficult to estimate - if a financial input for science is made when and how much of it will come out in technology ? One of the main differences between science and technology is that a time-table cannot be set for science, but it can be done for technology, e.g. the moon-landing was a purely technological undertaking and could be planned with precision. On the other hand, if a time limit of one decade was set to find a cure for cancer, this would have failed. We can only say that statistically speaking, on the average good scientific research will be beneficial but where and when and in what area it is difficult to say.

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2. Science as a Human Aspiration

A concern with things other than material needs is essential. In Europe, in the sixteenth century, the material standard of living measured by any yardstick - life expectancy, food production, medical care, communications, etc. was worse than in Sri Lanka today.

Every society, country or civilization has had different aspirations and different ways of finding fulfillment, but they had one common factor that there were other goals besides improvement of standards of living. When there is a loss of interest in these aspirations, the civilization will decline, however, materially affluent it may be, as was the case with the Roman Empire. Material development is very important, but is only a tool to enable man to achieve higher things.

One of the sweeping preoccupations and aspirations of the twentieth century is progress in science and the exploration of space. Scientific activity must be a part [illegible] of the development effort in Sri Lanka. Only a small fraction of the total resources need to be devoted to science, but it is necessary for the image of the country. With the development of good science, it is possible in a narrow field for a country to rise to international standards in a short time. Less developed countries like India and Argentina have produced Nobel prize winners and this kind of success has had a national morale booster effect. Development means a chain of activities that would lead to an improvement in a country's achievements and aspirations materially and non-materially.

3. Science as an Influence on Man's World View

Scientists make certain implicit assumptions that all problems have solutions. This is a fresh view in contrast to the fatalistic attitude that we cannot change the course of things. Therefore, science can influence man's world view.

Another important influence of science is that a common methodology is followed by scientists all over the world irrespective of nationality. There are internal criteria in science to decide whether the methodology is right or wrong, and unlike criteria in other fields is not complicated by political affiliations, etc. Science should be diffused among a large part of the population and science education in general is of importance for an overall view.

It must be stressed that there is no science of science policy as it were. The approach is still very empirical and the literature has not solidified yet. There is a certain amount of consensus, but a wide range of controversial issues still exist.

DISCUSSION

Kannangara : At the British Association discussion in 1970, Professor Blacket expressed the view that the first three stage in the chain of activity were better undertaken in the developed countries and the rest of the chain could be implemented in the less developed countries.

Moravcsik : Some hold the view that it might be better for less developed countries to latch onto the end of the chain, but I do not think so. From the long-range point of view, it is necessary to have the first part of the chain located in less developed countries, otherwise we may not have the trained personnel to adapt the borrowed technology for production.

If X is the cost of production, the cost of the first stages would be approximately X/10. By transfering X/10 to production, we are not gaining much and the end-product would suffer.

Mendis : Lopez' paper stresses that luxury science done in developing countries is not universal. Multi-national corporations carry out the first stages in the chain outside the country and only the later stages within the country. This is an antiquated colonial set-up.

Moravcsik : It is best that internal criteria should be used in making decisions without mixing political ideologies.

RC de Silva : Most of our industries started with imported technologies. But when they are adapted to use local raw materials, etc. the development of the first part of the chain becomes necessary.

Tissaveerasinghe : It is difficult to answer the financial argument in favour of starting at the second part of the chain.

Moravcsik : In practice, what happens is that due to a misunderstanding of processes in many countries engineers are trained and used as technicians and scientists are trained and used as engineers. This mismatching leads to dissatisfied manpower which is not creative. If a faulty education process produces this situation, this is not an excuse for the misuse of people all along the line. We must train people for the jobs they have to do.

Tisseverasinghe : The chain should be considered as a whole. It is a mistake to compartmentalise, because it gives the impression that step 2 can be done without step 1.

Wijesekera : Scientific knowledge becomes obsolete and unless a scientist remains an active researcher, he cannot keep abreast of knowledge.

Moravcsik : The quantum of scientific knowledge is immense. These are two million articles published every year. Even if all the available technology at given time is taught, a technologist cannot use new knowledge if he is trained only for technology because his training is limited.

Pattiaratchi : We cannot generalise too much. Stages 1 and 2 have to be used depending on the product to be manufactured, the circumstances, and the particular country, etc. For example, for the manufacture of blades the technology can be imported, but in the case of ceramics the type of technology will depend on the nature of the raw materials.

Laurentius: How do you differentiate between the training of a scientist and a technologist ?

Moravcsik : There is a different aim and orientation in the training. A scientist should be educated so that he has the ability to generate new knowledge. A technologist may have limited scientific knowledge, but he has to use production methods and processes and should be acquainted with them.

Ratnayake: A technologist is in a sense an applied scientist. Therefore, in our set-up, we should have scientists and technologists.

Moravcsik : An applied scientist is not a technologist, we have to generate some additional knowledge before adapting technologic. processes to local conditions. This is applied scientific research. Then the technologist takes over and makes the new processes.

Laurentius : There is no differentiation in this country.

Moravcsik : This is what I meant by the misuse of personnel. High level technologists have to be specially trained.

Kannangara : Isn't it a luxury in the less developed countries to have pure science. Instead, we should produce technologically oriented scientists.

Prelis : The controversy arises becuase we consider it as a chain. It should be an endless chain with inter-connecting links. Most production results from some existing technology.

Moravcsik : The entrepreneur and the technologist cannot direct the scientist into new areas of research becuase his outlook is limited. New break-throughs come from pure science. For instance, research on solid state physics of semi-conductors resulted in the development of the transistor.

Abeywickrema : I agree that there are cross connections. The output of the scientists may not be immediately related to production requirements. A close link between scientist and technologist is necessary to take it down to production level.

Moravcsik : A scientist not only produces his own research, but is a repository of scientific knowledge. He can only play that role if he continues to work actively and produce knowledge himself.

Wijesekera : Is it a hybrid of scientist and technologist that we need in our country ? We are often forced to indulge in both activities.

Prelis : Shouldn't scientists be directed into this cycle and motivated by the needs of production ?

Moravcsik : You cannot build up a scientific community that is only production motivated. If you try to save on pure research, you will lose everything.

Goonetilleke : How do you relate the economic division of the world to the scientific division ?

Moravcsik : Economic disparities are not based on natural resources, but primarily due to gaps in know-how. The share of resources continues to decrease becauee of these gaps.

Ratnayake : According to Rothschild, 70 per cent of the science budget should be on customer-contractor basis and 30 per cent on laisse-faire.

Moravcsik : Science policy should be directed towards achieving a critical mass in selected spheres.

Mendis : Less developed countries are at a disadvantage in the bargaining process in acquiring technology. The people in power in less developed countries have no scientific background and it is upto the scientific community to make them more aware of these problems.

Moravcsik : Even in developed countries, politicians have a minimal understanding of science. The problems of the less developed countries should be spotlighted by articulate local scientists at international conferences and they should indicate specific areas where the international scientific community can help to redress these problems.

Wijesekera : Is there a derivative culture in science, and a tendency towards scientific colonisation ?

Moravcsik : It is the nature of science that the prominent centres of the world would influence others. This type of interaction is not necessarily bad. If internal criteria are used, we need not worry too much about scientific colonisation.

Mendis : There is evidence of science and technology advances in ancient Sri Lanka. There seems to be a dichotomy between ancient and modern technology. Accupuncture is an example of our recent interest in traditional technology.

Moravcsik : Sixteenth century science was quite different from modern science. There was very little theoretical understanding. It was mostly philosophical or empirical. Three thousand years of science accumulated very little knowledge. Within three hundred years we have accumulated much more. Accupuncture is more technology as it was developed purely by empirical methods.

Goonetilake : Recent discussions on science policy deal with socio-economic aspects. According to Kuhn, science does not develop continuously, but in spurts. Merton writes on the structure of scientific society and claims that scientists like to compete.

Moravcsik : What Kuhn says is generally what most working scientists know, namely that science grows in what he terms "paradignes". However, this is only one aspect of scientific activity. Scientists are a section of society which can most easily interact

With each other, and the developments in one discipline can have an immense impact in an entirely different one, opening up avenues of work not previously anticipated.

Mendis : The social basis of science has been diagrammatically explained by Herrera, with links between the modern and traditional sectors and the centre.

SESSION II - SCIENCE EDUCATION, MANPOWER & PLANNING

Professor Michael J. Moravcsik

SCIENCE EDUCATION

Science education has two aspects : to provide a general science education to everyone and special education for practitioners of science. Much of the efforts in science education are in the wrong direction, e.g. the content, method of instruction, and the emphasis on memorisation and reproduction of rote knowledge. Modern science is not a closed subject and information doubles every seven years. What should be stressed is the spirit of science, attitude and methodology and the art of problem solving. Science is quantitative and any kind of activity is tied to some magnitude. Science teaching must emphasise the ability to make estimates.

Newspaper coverage of science is generally poor and the quality low, because it is difficult for journalists to have competency in all fields, Most articles on science spotlight technology rather than science. They do not give an idea of what scientists are doing, how they do it and what problems they face. Scientists should participate in propagating science through media by writing popular articles and giving lectures in schools, etc. Unless the basis of science understanding is there, bureacrats and administrators are not surprisingly casual and indifferent to the problems of science.

In specialist education memorisation is unrealistic. One possiblity is the open book examination. This method develops better understanding, but the problems are more difficult to devise. The system of external examinations tends to inhibit any kind of educational experimentation. Another problem is premature specialisation. The disadvantage is that students get confined to a narrow field and the basis is not broad enough to adjust to new situations.

This flexibility is even more important in applied research because the base is broader and applied research problems are usually inter-disciplinary. Other things being equal, education should be done locally. However, often factors dictate that training at first has to be abroad. As a method of ensuring that trained scientists return, the bond is not very effective or desirable for two reasons. One is that if he gets a job abroad, he can pay the bond anyway and the other is that the relationship is reduced to financial terms.

The nature of the educational process is such that even if a small fraction of those going abroad return and do well, the financial outlay is repaid.

Manpower

Critical mass is essential at a particular geographical point, or de facto so, because scientists need interaction with others. This generates criticism, discussion and team work which is very important for the creation of new science. Some countries such as Korea have detailed manpower plans for the future, but how far in time can you plan and to what extent ? Only approximate predictions are possible because of the low efficiency of output. Only a few really come off.

The rigidity that has to accompany detailed manpower planning is not desirable because it restricts the mobility of scientists. The primary purpose of science is research. Everything else is auxiliary. Science policy, science education, etc. are only means to improve research activities. Productive scientists should therefore be encouraged.

The distribution of scientists who produce x papers is $1/x^2$. The most productive scientists fall prey to the brain drain. Quality is more important than quantity. Really outstanding scientists are necessary for leadership, e.g. Raman, Bhaba and Saha have shaped Indian science. Sometimes the word 'elite' is used to categorize scientists who cannot be moulded into government policy. But this consideration is irrelevant. Science is an 'elitist' undertaking where men of quality count most. International scientific links are possible through such scientists and every effort should be made to keep them within the country.

Evaluation of scientific output is difficult. It is, however, necessary to quantify to convince planners and obtain funding. Internationally recognised scientific criteria have to be used.

DISCUSSION

Mendis : In our context, it is not only the top level, but a whole cross section of sciebtists who are subject to the brain drain. Those who have left seem to be more productive. Is it due to the better facilities ?

Moravcsik : It is difficult to determine. A study was made in Turkey. A mediocre scientists will find it more difficult to find a job abroad than a good one.

Kannangara : What ground work has been done there to get them back ? Has any country succeeded in doing so ?

Moravcsik : Yes, South Korea and Brazil. Money is not the major factor in leaving. The salary is only relative to that of the rest of the population. Even in developed countries scientists are not relatively highly paid. A sympathetic attitude by the government is more important. There is more leverage in directing research and more opportunities for leadership in less developed countries.

Tisseverasinghe : A statistical analysis has been done by the Colombo Plan. It shows that material incentives are not the major considerations.

Kannangara : The problem of equipment and accessories is a serious drawback in the less developed countries.

Moravcsik : Certain international organizations are willing to provide equipment for public relations. The more difficult problems are provision of spare parts and repairs. One solution is to have a roving repairman for the region. Co-operative research between institutions in developing countries linked to institutions in advanced countries such as done in India and IRRI in Philippines is another possibility.

High morale is necessary for successful scientific research. In some of the advanced countries morale is declining and is lower now than it was ten years ago. On the other hand in the less developed countries, morale can rise provided they set their goals and guard against disillusionment spreading from the advanced countries.

Tisseverasinghe : In Korea, science developed due to the commitment of the government, which sponsored KIST and KAIS.

SESSION III - COMMUNICATION, MANAGEMENT & PLANNING

Professor Michael J. Moravcsik

Science is probably the most cumulative activity of man. Progress in science is based on the efforts of many people throughout the centuries. As knowledge accumulates it is simplified and compacted. This is the reason why tremendous progress has been made in the natural sciences. In the humanities, knowledge has not been cumulative and progress in the social sciences has been relatively slow.

Communication is very important in science and is of two types : internal - that is within a country and external - with scientists outside. In many countries, internal communication is weak compared to what it should be. Much can be done in this area as it does not depend on foreign exchange or bureaucracy. Strengthening links in internal communication will help in creating the critical mass. Interaction can be fostered by seminars between groups, accessibility to local journals and local publications of all good research, even if it means double publishing.

The structure of international communications is such that the scientifically rich get richer and the poor get poorer. Most scientists want to maximise immediate scientific progress and consider it reasonable to feed information to the most productive research centres. One quarter of the world's population produces 92 per cent of scientists. If the remaining three quarter is developed, science will progress even faster.

International journals and reports are difficult to get due to the cost. Microfiche and microfilm would help to reduce cost, air freight and storage space. Sophisticated methods of information storage and retrieval are not essential, but a simple system of obtaining the basic sources of information should be available.

Organization and Management

1. Science policy (within or for science) is a set of actions designed to create a context in which scientific work can be done.
2. Science policy (with science) is the use of science in multidisciplinary problems with a scientific constituent.

Active scientists should be involved in the so-called science policy making process. Many organizations are concerned with science policy, e.g. Unesco. There can be no science policy without science.

Science policy consists of planning, decision making and implementation. Of these three activities, planning is the most popular. But it is only a small part of the exercise and may not even be necessary, except for some overall channelling and development of manpower and allocation of resources. For instance, the United States never had a science plan. Because science is not a predictable undertaking and the products of science are intangible, it is not possible to plan science like a manufacturing process.

Some national development plans use measures such as the number of scientists to be produced over a certain number of years. This is [illegible] confusing input for output. Science output can be measured in terms of output of knowledge, but this is not easily evaluated.

Evaluations

Production of science can be quantified in terms of publications, citations and transfers of technology. Another method of assessment is by peer judgement. When a research grant is required, it is customary to write a proposal setting out the objectives and estimating the funds required. This is evaluated by other scientists in the field before a grant is given. This method works fairly satisfactorily though not perfectly. It is necessary to establish internationally accepted objective standards to assess the state of science in different fields. This kind of evaluation is seldom done, because the local community may be too small and there is a reluctance to use foreign scientists. This is not justified as science is international and one can always select a group of scientists of several nationalities to arrive at an even more impartial assessment. This should be done every five years, and the cost will not be exorbitant while the pay-off will be great.

Decision making should involve people who at sometime were involved in scientific activity and implementation, which is converting decisions into critical action, should be done only by scientists.

Usually only 10 to 20 per cent of R & D is spent on basic scientific research. In many countries, the quality of basic research is better than applied research and the impression is created that more basic research is done, but this is not so. Every good piece of scientific research should pay off at sometime or another. Hence there is no clear-cut distinction between basic and applied research. There is only a difference in time factor. For instance, Rontgen diecovered X'rays accidently, but they were being applied in hospitals within three months of the discovery. Even private companies spend a certain percentage on basic research in the hope that one new discovery will pay for all the expenses involved.

In making research grants, two methods can be applied.

(1) The egalitarian method where the money is equally divided all along the line. This method is useful in building up institutions.

(2) The evaluation method where the proposals are evaluated and the money divided accordingly. This involves more thinking and complicated decision-making, but the pay-off is greater. However, there is also a greater chance of makkng a mistake.

A judicious combination of both systems would be the best answer.

DISCUSSION

Tisseverasinghe : Does planning involve deciding priorities in building areas of science ?

Moravcsik : Some claim that it is not possible to build up science in a country giving emphasis to particular areas. According to Derek de Solla Price in all countries, the balance between fields of science is very much the same. But historically this is not so. In many countries, some fields are better developed than others. For example, in Latin America and the Philippines the biological sciences are better developed than the physical sciences. In a small scientific community, there is no alternative but to build up science around people with proven scientific leadership. If a new field such as Oceanography has to be developed, people have to be trained abroad in the first instance and a critical mass developed. These people should not however, return to a vacuum.

Ratnasiri : The quality of manpower in science is also important. There is a tendency in Sri Lanka for the better students to take to engineering and medicine.

Kannangara : This trend appears to be declining now. More motivated students of better quality are taking to science.

Abeywickrema : What happened in USA is not applicable here. They had a set of highly motivated people with ample resources. We are trying to telescope into ten years developments that took a much longer time. Like the GNP gap, the science gap is also increasing.

Before the war, our university facilities compared favourably with UK. But now the situation has deteriorated here while UK has relatively progressed.

Moravcsik : The human mind is attracted by the idea of centralization. However, too much centralization can take away initiative and create friction. To get the active co-operation of scientists, they should be involved in decision making. Policy within science is universal. Policy for science is much less universal and changes from country to country, but the more people involved in the input, the better the policy is likely to be.

Wijesekera : Would you comment on foreign policy within science policy ? There is a feeling among scientists that satellites are being built up in science, and fears where a 'derivative culture' in science could result have been expressed.

Moravcsik : There is a danger in trying to politicise all international science co-operation. Developing countries should diversify their sources and develop indigenous capability both for economic as well as for psychological reasons. Resources could be drawn from a variety of sources.

Tissaverasinghe : What are your views on the language in which science should be taught ?

Moravcsik : A good elementary vocabulary of science is necessary in every language, but it takes a fair amount of time to develop a full scientific language. It is also necessary to have an international language and English happens to be the current international language through a process of historical development. A hundred years ago, it was French and German. Hence there is no political significance. All Russian research publications are translated into English. French and German publications are not so prolific, but there are usually abstracts in English.

SESSION IV - SYNTHESIS & PROPOSALS FOR THE LOCAL SCENE

After some discussion, it was decided to adopt two sets of recommendations to promote the development of science in Sri Lanka.

(a) What scientists should do among themselves

(b) What government bodies should do in collaboration with scientists.

RECOMMENDATIONS

Group A

1. State of science
   (a) Investigate scientific knowledge about Sri Lanka
   (b) Assess scientific capability in Sri Lanka

2. Identify gaps and inadequacies.
   (a) Identify gaps in our present knowledge and capability
   (b) Identify deficiencies in current scientific activities

3. Choice of fields of research - Selection of appropriate fields for scientific activity from time to time.

4. Evaluation mechanism - Evolve suitable evaluating procedures for scientists and scientific research.

5. Local scientific interaction - Increase interaction between local scientific groups by seminars, discussions, etc.

6. International scientific interaction - Encourage collaboration with foreign scientific groups.

7. Strengthen links between scientific knowledge and technology. Evolve mechanism to shorten the time-lag between bench results and their technological application.

Group B

1. State commitment to science - Emphasize the importance of high level state commitment for scientific progress.

2. Inputs for development
   (a) Personnel
   (b) Local funds
   (c) Foreign exchange
   (d) Aid components

Scientists should take the initiative and indicate to the administrators their specific requirements in each of these groups.

3. Involvement of active scientists in science education at all levels.
4. International language of science - While recognising that the dissemination of scientific information in the national language is of prime importance, as far as higher education in science is concerned, it is recommended that an international language of science be used, which in the present context should be English.

A vote of thanks to the Guest Participant, Professor Michael J.Moravcsik was proposed by Mr. D.B. Pattiaratchi.

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