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ACCESS TO TECHNOLOGY AND INNOVATION

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The end of World War II (1939-1945) brought about with it rapid scientific and technological development in the industrialized countries of the world. In the years following the war, the economies of the developed countries expanded extremely rapidly, giving rise to better standards of living in those countries. At the same time, the developing countries (most of them being colonies at the time) were attempting to free themselves from colonial bondage. This fact combined with that of these countries, in the main and with very few exceptions, having rapidly expanding populations and being raw material producers, resulted in the developing countries being hard put to improve their economies. While the cost of import of capital equipment and consumer goods into developing countries increased several fold, the export earnings of these countries virtually remained static. These are some of the factors that brought into sharp focus the "technological gap" between the developed and the developing countries.

Much has been said and written about this gap, as indeed as has been about several other gaps between the developed and developing countries. It may be worthwhile to examine here some of the causes for this gap. Consumable materials, labour and capital are three of the major inputs that go into the generation of goods and services. Geographical location and the events of history have enabled some countries to use these resources to the fullest extent. Developed states with natural and capital resources have been able to attain a level of productivity much in excess of the demands of their population. The poorer countries with fewer resources and meagre capital but with abundant labour find a large number of their people at subsistence or even below that level. The commitment of resources to research is another factor that gives the developed countries a great advantage. Perhaps. the most important causative factor in the gap is innovation. Innovation is the process by which, from the time of conceptualization, an idea goes through several processes such as research, development, production and marketing, ending up in a product, technique, or process. Although some of the developing countries have scientists of outstanding calibre, their research results rarely leave the laboratory bench. In contrast, in the United States of America, which is the most technologically advanced country in the world, there has been a demonstrated ability to move research results from the laboratory to a marketable product technique or process.

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What has been done to bridge the gap? Historically, if we look at the transfer of technology, it has been an unplanned process. Today, the process is well-organized and planned for those who need it or lack it. The older methods of transfer still take place though the processes are slow, while modern methods are relatively quick with inbuilt feedback mechanisms for assessing success or failure. It has always been felt that dissemination of information is an essential process in the development of technology and an efficient mechanism for its transfer. For the process of innovation or technology transfer it has long been recognized that a Technical Entrepreneur, sometimes also called a "product champion", is necessary.

The international transfer of technology has taken place through several means, the most obvious being from government to government. The United Nations and other inter-governmental organizations have also been important channels. Some of the technical agencies of the United Nations like WHO, WMO, ICAO and UPU have functioned very efficiently in the field, in spite of all the political, social and economic diversity of the member nations of the U.N. Related agencies of the U.N. like the World Bank and UNDP through funding development projects also finance a technical component which is transferred. Technical assistance and economic aid is another form. However, the business channel is the biggest mechanism for the transfer of technology, and this is done by licensing and know-how agreements. Direct investment by foreign companies is another method.

There are also indirect methods of transfer of technology such as from person to person and from interchange of students and teachers from developed and developing countries. Finally, there is the simplest method, that of reading a scientific or technical journal.

As far as the developing countries were concerned, the question of access to technology came into focus after World War II. It may be worthwhile here to spend some time in looking at the development of science and technology in one of these countries. Obviously, Sri Lanka is the example that I am most familiar with, and I shall now attempt to briefly do this.

Sri Lanka achieved independence in 1948. The major research emphasis till that time had been on the plantation crops: tea, rubber and coconut. Three research institutes had been set up for the purpose and even then their main objective was increased yields of the commodities and hardly any emphasis was placed on technology. The Department of Agriculture too, had a small research unit which concentrated merely on rice and a few subsidiary food items. In addition, there was the Irrigation Department, the Department of Mineralogy, and a small Fisheries Research Station. This, by and large, was the scientific set up of the country at the time of independence.

The University system of Sri Lanka in 1948 was geared in the main to produce administrators, teachers and doctors, and at the time of independence there were only the Faculties of Arts, Science and Medicine. In 1948 an Engineering Faculty and in 1954 an Agriculture Faculty were created. About this time, a Law Faculty was also introduced into the system. Soon after independence, successive governments of Sri Lanka were interested in social welfare measures, and the main emphasis was placed on education and health. The result was a proliferation of humanities graduates who are at the present time finding difficulty in securing employment commensurate with their education. Government also created a second Medical Faculty in the late fifties, and two more recently in the seventies. A private Medical College has also been established. When Sri Lanka faced difficulties with her balance of payments in the late fifties and early sixties, plans were initiated to set up a second Engineering Faculty which came into being in the mid sixties. While these changes took place, the only Science Faculty continued in existence. The creation of applied science schools like medicine, engineering, and agriculture came from the initiative of government; the University community on the other hand, pressed for the creation of more schools of natural science, resulting in the establishment of four schools toward the end of the sixties. Today, there are seven Faculties of Science in the traditional Universities. The Open University is scheduled to start its Science courses in January 1984. More recently, diversification of courses has taken place in the University system with the introduction of Management, Commerce, Development Studies, etc., to name a few.

It will thus be seen that a gradual transformation of teaching at the undergraduate level has taken place in Sri Lanka during the past twenty-five years or so. Until recently, there was hardly any post-graduate education in the field of science and technology in the country. The majority of students had their post-graduate education in the developed countries, mainly in the U.K. and U.S.A. In the seventies, the University established a post-graduate Institute for Medicine, a post-graduate Institute for Agriculture, and a post-graduate Institute for Pali and Buddhist Studies, among others. There is still no formal institutional framework for post-graduate education in Science and Engineering, the training in these areas being undertaken only on an *ad hoc* basis. However, plans are being drawn up to rectify this position.

It may now be pertinent to take a look at the infrastructure for Science and Technology in Sri Lanka. Soon after independence the Sri Lanka Association for the Advancement of Science (SLAAS) suggested to government that a National Research Council be set up to give an impetus to the development and coordination of Science and Technology policies in Sri Lanka. As a result of these initiatives, and on the recommendation of an IRBD team, the Ceylon Institute of Scientific and Industrial Research (CISIR) was set up in 1955. However, no Research Council materialized. The CISIR was set up on an American model, and after an initial grant from the government for five years, it was expected to be self-sustaining. However, industry in the country was in its infancy and the expected income and contracts for research from the industrial sector was not forthcoming, indeed it was non-existent. In the early sixties, the CISIR ran into financial difficulties and the government stepped in and made it a statutory corporation receiving an annual grant. The CISIR objectives sought it to be a multidisciplinary research institute. However, the goals of the institute were ill-defined and it really became an institute with multiplicity of disciplines each without a critical mass of scientists to produce really effective results. Recently, clear-cut policies have been laid out for the institute, recruitment of staff has taken place, and more facilities are being provided. The CISIR has done quite a lot of good scientific work during its thirty years of existence, but lack of adequate pilot plant facilities have hindered the translation of bench research work to industry. These deficiencies are now being corrected.

Even after the setting up of the CISIR, the scientists of the SLAAS continued to press for the creation of a Research Council. Finally, in 1968, the National Science Council of Sri Lanka was created by Act of Parliament. The Council was vested with the responsibility for the following functions :

— to advice the Minister on all matters pertaining to the application of science and technology to development,

— to co-ordinate research in various departments and research institutions,

— to promote both fundamental and applied research,

— to formulate a policy for science and technology for Sri Lanka.

The major governmental organ on Science and Technology policy in Sri Lanka is the National Science Council. Its functions are not purely advisory and the Council by statute has been empowered to actively support research. It has also been vested with the authority to make grants in aid of specific research projects and to erect, equip or maintain research units or laboratories either independently or in association with any other organization involved in any sphere of scientific activity.

A committee was appointed to review the work of the Council and to examine in depth the constitution and objectives of the Council. The recommended changes to the present legislation were accepted by the government, and the Council functioned with effect from 1 January 1976 under a new Law enacted by the National State Assembly. Recently, in 1982, the

National Science Council was replaced by the Natural Resources, Energy and Science Authority of Sri Lanka by Act of Parliament, but the functions remain very much the same.

The Bureau of Ceylon Standards was set up by government in 1964.

The Industrial Development Board was set up by government in 1969.

The National Engineering Research and Development Centre was established in 1974. The main objective of this institution is to promote, foster and develop indigenous technology. It has also been commissioned to look especially at the innovative process and application of research results to development and industry.

It was only in 1976 that the government approved the establishment of a National Scientific and Technological Information Centre under the auspices of the National Science Council.

As a means of quickening the pace of development, Sri Lanka, as indeed is the case with many other developing countries, has set up a central planning organization which has the overall task of providing the framework for development.

It will thus be seen that it has been only in the last two decades or so that a systematic approach has been made towards providing the scientific and technological infrastructure for development.

Since independence, one of the biggest barriers to development of technology has been the attitude of the entrenched bureaucratic elite of developing countries. In the years immediately following independence the administrative hierarchy of these countries, lest they lost some of their privileges, were happy to use the services of foreign experts rather than those of their own scientists and technologists. Governments, too, at this early stage, did not realize this and as a result there were pay differentials between administrators and technologists. The facilities and conditions of work for technologists were poor and indeed in most cases, their employment was not commensurate with their training. In fact, most of these people were professionals highly trained in the developed countries of the West and their services were often underutilized and very frequently not utilized at all.

The net result of these pay differentials and underutilization of the services of these scientists and technologists was that it left them in a dire state of frustration. Consequently they migrated to the more developed countries causing the much talked of "brain drain" and making it more difficult for the developing countries to attain a critical mass for their scientific and technological potential.

Another important factor which had inhibited the development of technology was the inordinate hurry with which the developing countries wanted to modernize their economies. With serious problems of over-population and food production being inadequate to meet the demands of these populations, there was an urgent need to develop. However, one fact that seems to have been overlooked is that Western industrialized society had gone through an evolutionary period of around three centuries. Another factor that has to be kept in mind is that in the transfer of technology, the social and cultural values of the society that receives this technology must be borne in mind.

I have previously dealt with, at fair length, the infrastructure for science and technology in Sri Lanka. Most of the institutions set up within the last fifteen years or so have been formulated by Sri Lankan personnel and implemented by them. My own personal feeling about access to technology is that, whatever the conditions for the transfer, the recipient must have the technical expertise, receive it and use it profitably. Two of the most important areas for development in order to have this access are infrastructure for science and technology and excellent schools of post-graduate studies in the universities. As I have detailed before, Sri Lanka has now taken the necessary steps to achieve these two objects. It is in fact very encouraging to realize that the first phase of the biggest development project undertaken by Sri Lanka, namely, the Mahaweli Development Project, has been completed in 1976 by three state organizations, namely, the State Engineering Corporation, the State Development and Construction Corporation and the Ceylon Electricity Board, manned almost entirely by engineers and scientists from Sri Lanka. Under the present government's accelerated Mahaweli Project, construction of the major reservoirs should be completed by 1986.

What of the future? The United Nations and its specialized agencies have done much for the process of transfer of technology. The World Plan of Action for the Application of Science and Technology to Development, prepared by the Advisory Committee on the Application of Science and Technology to Development for the Second U.N. Development Decade in 1971 laid down the following guiding principles for both the developed and developing countries:

(a) The necessary basic structures, policies and institutions and a team of skilled personnel should be built up as quickly as possible in the developing countries.

(b) Arrangements for the transfer of existing technical and other knowledge should be improved and its practical application in developing countries promoted.

(c) The scientific and technical efforts of the developed countries and the U.N. System, in close co-operation with the developing countries, should be concentrated on problems of urgent importance to the developing countries.

With regard to access to technology, the World Plan has this to say :

> "The problems of removing the tariff and non-tariff barriers to trade have received close attention in international forums in post-war years and the policies of improving the access of exports of Primary products and of manufactures and semi-manufactures of the developing countries have achieved a certain measure of success. In sharp contrast, it is striking indeed that the questions connected with improving the access of the developing countries to modern technology have so far not received sufficient attention.
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> "Multilateral action concerning improvements in the existing channels and reduction of relative costs of the transfer of technology to developing countries could constitute the initial stage for reducing some of the current constraints on the transfer.
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> "In addition, more serious consideration than has been the case hitherto needs to be given to some of the proposals which have been already advanced for improving the access to technology. These proposals include, among others, a world bank for technology, the modernisation of industrial property law and administration, and systematic processing of technical documentation contained in patent information.
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> "Besides these, consideration needs to be given to developing new areas of international action: for instance, concessional finance for the transfer, the establishment of 'most-favoured-nation' treatment in technology transfer (as is common in trade), the introduction of a system of preferences for technology transfer, and regional and sub-regional co-operation among the developing countries themselves for accelerating such transfer."

During the last two decades, much discussion has taken place at national, regional and international levels on these questions, as indeed we are doing at this very moment.

In my opinion, hope for the future is not too dim as many are wont to predict. Access to technology, even if freely available, would not be of much avail if the receiver is incapable of accepting it. Technology, like Science, is universal and should be shared by all. Indeed every single nation has some technological capability. It is from this capability than an indigenous technology should be developed keeping in mind that as in the case of science there is only one standard for technology, namely universal. Two essential pre-requisites exist for attainment of this goal, one being that of a suitable infrastructure for science and technology in a country and the other, excellent schools of post-graduate study in the University system of that country. No amount of foreign assistance could replace a good indigenous base for science and technofogy. Foreign assistance is required and it should be regarded as a means to an end, the end being self-reliance.