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Science in a Developing Country

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Any discussion of the basis of science in a developing country has often been justified both in terms of science as a human aspiration as well as a base for technology. For centuries, science and technology remained and developed independent of each other. Technology, known as the industrial arts, was largely empirical and provided little interest to the intellectual classes and it did for a long time remain their monopoly. It was only about the middle of the nineteenth century that it was realised that science and technology stimulated the growth of each other. Technology is now more science-based than ever before. Today's science is tomorrow's technology. The distinction between the roles of science and technology in our strategy for development is of great significance to any developing country. Although it would appear that the present need is for a greater emphasis on technology, it is essential to promote and sustain science in all its aspects. After all, to apply science, one must first know it.

The effects of Science are long range. *Ad hoc* solutions could never be an alternative to planned scientific activity. There is a remarkable passage from a lecture by Clerk Maxwell over a hundred years ago. "For us who know only the spirit of our own age, and the characteristics of contemporary thought, it is as impossible to anticipate the general tone of the science of the future as it is to predict the particular discoveries it will make. Experimental science is continually revealing to us to new features of natural processess and we are thus compelled to search for radically new forms of thought for their description."

It has often been remarked that it took 50 years for Faraday's experiments in electromagnetism to reach practical fruition. Farsighted programmes are therefore needed to train our own scientific community, tradition and institutional base for science.

Science in developing countries.

This should be supplemented by a few words on what is understood by development. It is very appropriate to quote Professor Colin Leys of the University of Nairobi from his address to the 5th Commonwealth Education Conference in which he states "The very expression 'the developing countries' has come to sound embarrassing because it so obviously rests on the linear conception and frequently refers to countries which are in fact stagnating or even regressing. It begs the central question which has been asked, namely, what is development? and the critical questions which follow from it. What are the causes of underdevelopment? What are the solutions to be adopted? What kind of society should development create? How valid are current development policies? How far even, can existing governments claim to be the sole interpreters of of what should be done? I add this last question for the sake of candour. We used also to assume that development would bring benefits to everyone. There was a tendency to ignore the fact that some would even lose."

A fairly reliable indicator of a country's development is the extent of its scientific and technological activity. In this respect countries in the developing world—the 'third world' as they are politically labeled are characteristically underdeveloped. There is little evidence of any indigeneous science and what little has been needed has for the most part been imported. It is only recently that there has been any real concern for development.

The organisation of science on a national scale in Sri Lanka, is very much of recent origin. But in this task much has been achieved through the efforts of voluntary science associations.

A small band of scientists got together in 1944 to found the Ceylon Association of Science. It is particularly relevant to note that the intitiative for this venture came from the Ceylon Chemical Society founded a year earlier in 1943. The chemists have always been in the forefront of scientific activities in Sri Lanka. As an Association, its objectives have been to promote the application of science in two broad ways: (*a*) by promoting scientific research. (*b*) by dissemination of scientific knowledge. In promoting science through research, all that the Association was able to achieve in its formative years was to make available a forum for the local scientists to present and discuss their researches through the holding of annual sessions. It was soon realised that this alone was not adequate to provide all that is required to create a favourable climate for for scientific activity. It was also recognized that the Association should bring into its fold all disciplines of science and encourage in them discussion among themselves as well as among the scientists from other disciplines. The Association was soon re-named as the the Ceylon Association for the Advancement of Science following perhaps the pattern of the British Association for the Advancement of Science and aimed at establishing live contact between scientists and the people. As the late Prime Minister of India, Jawarharlal Nehru once said at one of the annual sessions of the Indian

Science Congress "My interest largely consists in trying to make the Indian people and even the Government of India conscious of scientific work and the necessity of it." Politics cannot be kept out of science nor science out of politics. After all politics does matter and no amount of preaching on the glories of science is going to bear fruit unless our politicians are conscious scientifically and begin to show their faith in science by giving much support to its organisation.

Apart from sectional activities of the Ceylon Association for the Advancement of Science, the Association began to achieve its second objective of dissemination of scientific knowledge. The general image of scientists that they are far from the understanding of the common people working in some sort of ivory tower needed to be erased if this live contact with the people had to be established. As science and technology affects lives of ordinary men and women, it is essential for scientists to put across to the people what they are doing and also to get to know the thinking and viewpoint of the people. This the Association realised as one of its primary functions. It set up a committee for the popularisation of science pledged to raise the level of science consciousness among the entire population. One major problem has been to try to bring home to the layman the close relationship between science and its environment.

The Association in its early years gave much emphasis on the organisation of scientific activity as a whole and persistently campaigned for the creation of a National Research Council for overall co-ordination of scientific activity and to define a National Science Policy. Successive governments in Sri Lanka were urged to give this matter its urgent consideration. It took over 15 years to realise this long felt need. In the ensuring years, a shadow committee referred to as the General Research Committee was formed by the Association to promote scientific research by the awards of research grants and the undertaking of documentation. A directory of scientific personnel and a union list of scientific periodicals in Sri Lanka was produced by this Committee. It also undertook to visit industrial corporations to identify scientific problems with a view to bringing to bear scientific knowhow among the members on these problems. In 1968, the government instituted a National Science Council to promote and co-ordinate scientific research and science-based activities. Shortly afterwards, the government created a separate ministry for scientific affairs. Much remains to be done but the infrastructure, hopefully, has now been firmly established.

Having considered, in brief, the status of science development in Sri Lanka, the need for each developing country to formulate a national science policy appropriate to each country is apparent. In any area of scientific activity, whether it be agriculture or industry, there is a need for the development of a science policy for maximum utilisation of science, to assess indigenous, scientific and research capability within the country, to refine techniques for acquiring and distributing technological information for effective use, and more important to lay down scientific priorities for that country. In manpower planning, much attention should be paid to the question of a critical mass, because scientists need interaction with others. This generates criticism, discussion and teamwork which is of importance in the creation of new science. It should also be one of the features of a National Science Policy to give due attention to the study of areas where benefits may be derived through more intensive application of Science and Technology. Most developing countries could aptly be described as poor rich countries—rich in their resources and potentials but their people are poor. The focus of attention of any development strategy should necessarily be on

(i) a comprehensive survey of the physical and human resources,
(ii) the utilisation of science and technology in the exploitation of the natural resources of a developing country.

On the question of autonomy in scientific institutions, the stress has always been on autonomy for spending. It is the intellectual autonomy for operational freedom to handle scientific problems that should be provided. Apart from a National Science Policy, there should emerge a national resolve of dedication to science. Ours is essentially an agricultural economy. The way which we use such assets as land and water require a stable scientific and agricultural policy. Improved agriculture is often the outcome of the work of the laboratory scientists where overall co-ordination and teamwork is an essential component. It is necessary to provide an improved atmosphere for research for such scientists to assist in the solution of problems related to their own national agricultural plan.

In industry, the limiting factors facing most developing countries are the lack of cheap power and the inadequate knowledge of our resources. In Sri Lanka, (and I am sure that this is true of most developing countries), much of our resources have remained untapped or not exploited with maximum benefit. A few examples will illustrate this situation. In the eastern coast of Sri Lanka, black beach sands rich in titanium containing minerals, ilmenite, could virtually be scooped off by thousands of tons. This is exported to Japan at minimal cost where it is refined and beneficiated to recover from it the much priced titania and titanium. Could not this enrichment be accomplished locally? There is much chemistry and chemical technology in these studies. There are a variety of scientific and technical problems that need to be solved to achieve this end. I have read of similar problems elsewhere. Much of the concern in mineral exploitation in a country like Guyana has been to make the bauxite industry more efficient and more productive. Problems such as determination of moisture control to improve the efficiency of the calcination process and separation of

clay from the refined bauxite leads to the more technical such as the recovery of bauxite dust to reduce losses. Effective utilisation of waste products is another area requiring development. There is in this bauxite industry a growing interest in the red mud waste which contains as much as 10% titanium and quite naturally is seen as an abundant source of this valuable metal. The use of this red mud in making clay bricks could well be another concern of this industry. This is where identifying local material for use and applying modern science and technology to bring them to a point where they can be used becomes important.

A recent find in Sri Lanka are vast deposits of apatite phosphate mineral contaning about 35% P_2O_5. The economic potential of this apatite bearing rocks is yet to be realised. One major problem associated with this is the improvement of water solubility and consequent release of P_2O_5 to the soil. Much of the chemistry in the beneficiation process is still to be carried out. The experience of Uganda in establishing the superphosphate industry in Uganda is worthy of emulation. In a contribution to the 'Chemistry in Britain' Mr. Dyson who was a Managing Director of an industrial organisation in Uganda described the saga of development of the apatitite deposits in the Sukulu Hills in Eastern Uganda as a basis for the introduction of a fertilizer industry in Uganda. Such enterprises, he reports, had involved the education and training of skilled operatives and technicians in Uganda. This deposit first recognized in 1939 had to wait until the late fifties for economic exploitation. It is now a flourishing industry making granular superphosophate entirely acceptable to the farming communities of Uganda, Kenya and Tanzania.

In the food industry, much recent interest was shown in the use of cassava or sorghum in the manufacture of bread. The Tropical Products Institute in England has shown that these can be mixed in an almost equal quantity with wheat to give bread of excellent quality. This could be of great importance to some developing countries in saving imports by using locally available materials and even perhaps in efforts to 'fill the protein gap' since bread is one food in which protein supplements are acceptable to consumers. Work is also reported on a new technique for extracting coconut oil and at the same time isolating the protein which is present in the coconut milk—in the established process for obtaining oil via copra, the protein is largely wasted, yet there is often protein deficiency in these areas.

There are scientific as well as economic advantages in developing scientific and technological co-operation on a broader basis than the nation, particularly in a world as small and interdependent as ours. Problems of developing countries present common features where the experience of one developing country could be of mutual benefit to the other. The intensification of economic and technological linkage among the developing countries through both bilateral and multilateral exchange programmes can, to my mind, be of great mutual benefit.

There are one or two other matters which require mention. There is often the psychological aspects of the rather widespread feeling prevailing in most developing countries that anything foreign is superior to anything local. I believe that this pervades in our science and technology. In industry, nothing ensures the success of a product better than a foreign name tagged to it. It is necessary for the scientific community in particular to propagate a new wave of confidence in our own efforts and achievements.

Science and technology are only a part of a complex set of forces moulding society. Scientific and technological progress do not automatically result in human progress. A deeper understanding of the individual and society is important. It is here that the development of behavioural sciences play a useful role. The mental stresses and ailments caused by highly industrialised societies need to be understood so that the developing world would not fall a prey to these disturbing problems. The scientific community in any developing country should take note of the growth of social science areas of sociology, anthropology, economics and other behavioural sciences for the solution of some of their complex national problems.

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One of the most important elements of science and technology policy concerns the training and utilization of scientific research personnel and the consequent relevance of the education system to the requirements of the development of science. The training of scientists and research cadres must be planned taking into account possible changes in the professional structure of scientific labour, as well as the needs for specialized personnel for the various tasks of developing science and technology according to the country's particular conditions. At present much importance is accorded to improving the ability of scientists and research cadres to change from one field of research to another. A solution to this problem may be found in improving the system of training, retraining, a utilizing scientific personnel.

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