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feature articles

Science Policy in Under-developed Countries*

by Osmund Jayaratne
Chairman, National Science Council of Sri Lanka

"Today between 15 and 30 of the 120 countries of the world, with less than one-third of its population, possess practically all of its science. They spend more than 95 percent cent of the world's research and development funds..... Furthermore, these countries reaped in the past and are now reaping most of the direct economic, political, social and general cultural benefits of scientific research.....

The other countries—approximately 100 in number—with about two thirds of the world's population, share in various degrees the remaining one-twentieth of the world's science".[1] (Steven Dedijer in "Under-developed science in under-developed countries").

Those countries now characterised as under-developed or, more euphemistically, as the LDC's were once the proud seats of ancient civilisations. The achievements of China, of India, of the Middle East, of Latin America, and even of little Sri Lanka had much to contribute to the knowledge of modern man. However, casting aside mere sentimentality, it is necessary to admit that these ancient civilisations and their technical achievements were based upon empiricism, removed from science and scientific methodology as we know them today, from the processes of observation and experimentation, hypotheses, theory, verification and prediction which constitute the essence of that technique we use today to understand and control the world around us—namely, the scientific approach

Historically, for reasons that time does not permit me to analyse here, the development of modern scientific methodology occurred in Europe, spurred by the Renaissance and by the Industrial Revolution. From this stage onwards science begins to play a significant role as a factor in the social process—linked closely to the latter by its handmaiden: technology. In my opinion, it is necessary at this stage to clarify certain misconceptions that exist among our policy-makers regarding the relationship between science and technology and to correct the unduly sharp dichotomy that has been drawn between them. Both science and technology are today social activities. However, scientific activity relates to the exploration of the laws of nature and of society, whereas technology exploits these laws for the specific needs of society, particularly in the production processes. The two interact with each other and are closely interdependent. For instance, the Industrial Revolution and the invention of the steam engine led to the work of Sade Carnot and the development of the science of Thermodynamics, which in turn reacted upon and improved the efficiency of industrial processes. It is the failure to comprehend this relationship that has often led to such ambiguous classifications as basic, applied and development research. I quote from the Rutherford Memorial Lecture delivered at the University of Delhi in 1968 by the well-known physicist J. M. Ziman. His remarks are applicable to under-developed countries such as ours:

"I am speaking now of research without any more conscious aim than the understanding of how things are, or were, or might be. When money and men are short, it is by no means self-evident that an institute of theoretical physics, or molecular biology should take precedence over a tractor factory, a hospital or a school of civil engineering.

I simply cannot understand the intellectual snobbery of those silly people who give more credit for the discovery of another meson than for the design of a suspension bridge, and who cannot see that a zip fastener is a far more beautiful idea than a zeta function.

But the utilitarian argument against basic research can be carried too far. A certain amount of fundamental research must be sponsored in a developing country for a number of excellent reasons. In the first place the education of technical experts—engineers, doctors, agricultural advisers, even government administrators—cannot be left entirely in the hands of technologists of their own practical kind. Modern engineering, for example, requires the exercise of skills and the application of knowledge, acquired from pure physics, chemistry and mathematics. The rapid development of new techniques can only be exploited if the practitioners are adequately trained in these fundamental disciplines by teachers who are themselves in close contact with the latest theoretical principles. Only those who are actively engaged in research can truly absorb and re-transmit these new principles as they arise.

From a purely practical point of view, also, it is impossible to import technical know-how, and to apply it successfully, if one does not have available locally a corps of learned men to whom one can appeal for guidance on matters

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of pure scientific principle. Science-based technology is not a lusty crop of rules of thumb.....it is a delicate plant, which thrives only when tended by mixed teams of experts, including those impractical specialists to whom the buck can be passed when fundamental principles are at stake."

In the early days of science, the individual scientist could afford the luxury of working in his own laboratory, untrammeled by social demands and directing his activity to areas where curiosity led him. Today, particularly since the Second World War, science has developed into a viable social activity. For instance, the "pure" research of Hahn and Meitner led eventually to the release of atomic energy, which has transformed the face of the earth, posing the threat of the destruction of human civilisation itself—while simultaneously holding out the possibilities of a world of plenty in a saner society of the future. The solid state research of Bardeen and Brattain produced the transister which has in a similar traumatic fashion ushered in the age of electronics. In so far as science and technology have developed into social activities, by their very nature revolutionary and dynamic, they must and do necessarily interact with social and economic processes to the same degree as factors such as capital accumulation, supply of labour and other resources, land ownership and utilisation, population growth, political and legal systems. **Science policy** is an umbrella study and activity covering all the above fields which contribute to human welfare, with special reference to the dynamic role of the scientific process. In so far as scientists in their ivory towers can no more divorce themselves from the dynamics of social change and politics, planners and politicians can neither afford to ignore the role of science in social and economic development. In brief, science policy may be defined as a techno-economic policy, which concerns itself with the structure and organization of science and technology within a changing socio-economic structure.

The figures quoted by me at the beginning of this address, supplemented by further data compiled by Steven Dedijir [2], clearly show that under-developed countries are also countries without science. For instance, in 1960, while the USA, USSR and France respectively expanded 2.8, 2.3 and 2.1 % of their GNP on research and development, the corresponding figures for Ghana, the Philippines and Pakistan were 0.2, 0.1 and 0.1 %. Sri Lanka, on a rough estimate expands 0.25 % of its GNP on R and D. Science and technology are intimately linked with economic development—particularly with industrial growth. This has been the experience of the west. However, with the process of colonisation which was accelerated during the turn of the century, the fine balance which existed between domestic agriculture and handicrafts in the colonies was destroyed by the neglect of the former and by the subjection of the latter to competition with cheap, machinemade commodities from the West. Ever since, the colonial powers have resisted the introduction of industry into the colonial world and retained them as sources of raw materials and producers of commercial agricultural crops. This is not a climate conducive to the growth of modern science.

Once again to quote Stevan Dedijir [3]: "In under-developed countries there is less awareness in general public opinion of the importance of science, and this is intimately and reciprocally connected with the low priority given to science in development policy and to the carelessness about the cultivation of a scientific potential necessary to produce that science. The farmer, the craftsman, the educator, the civil servant and the politicians in these countries do not see the relevance of science to their concerns. And of course, in under-developed countries, there is not a scientific public...

The embryonic science developing in this environment will show in every one of its cells, that under-developed countries have underdeveloped decision-makers on science, under-developed research councils and science advisors, under-developed administrators of science and under-developed scientists. It is not that scientists in under-developed countries are technically untrained or technically incompetent, it is rather that being a part of their national culture, they will themselves lack, or will not be able to impose or recreate in their society and culture, so alien to science, those fundamental orientations which are necessary for really productive research."

Another constraint upon the development of science and technology in the Third World, which is a further heritage of colonialism can be summed up in the words of the recent Pugwash Conference of Scientists held in Madras: "In most LDC's the colonial powers created and left behind them a national elite—highly westernised, relatively privileged and divorced from the people. This elite and its successors constitute the bulwark of neo-colonialism in many LDC's, and prevents the development of specifically national economic and social forms." It is this phenomenon which partly leads to that attitude of mind which looks upon everything western as superlative and makes even certain members of our scientific community turn their backs on the challenges posed by the anti-scientific attitudes prevailing in the under developed world. There is no need to stress here the innumerable obstacles science and scientists have to face in countries such as ours—obstacles ranging from the lack of what might be called a scientific climate, the lack of sympathy and understanding on the part of governments to scientific research and the lack of awareness in general public opinion of the importance of science. Scientists of the Third World also suffer from the frustrating effects of isolation—the lack of communication with colleagues involved in their specific fields of research, the difficulties of international travel, and often, the lack of proper access to the world's scientific literature.

There is a growing consensus of opinion in under-developed countries that the artificial transfer of technology from the advanced countries—whether by governments or through the exploitative practices of multi-nationals—can only have, in the final analysis, a debilitating effect upon the receiving country. An appropriate technology must be

based upon a judicious inter-mixture of advanced technology, adapted to the specific needs of the country, with small-scale production units that utilise the traditional empirical techniques already existing with the injection of the proper scientific know-how. Production is a social activity. We must first and foremost focus on people, on the needs of the majority rather than those of an elitist minority.

While science is, or should be, an international activity, it must not be forgotten that the dichotomy of the rich versus the poor countries is one that affects scientific and technological activity as well. The latter do not exist in a vacuum. Academic and scientific colonialism is as much a reality as socio-economic neo-colonialism. While we of the Third World absorb and adapt to our own requirements the best products of western science, it is in our interests that closer links should be forged between the scientific communities of the poorer countries. We, in Sri Lanka have already entered into an Indo-Sri Lanka Scientific and Technical Co-operation Agreement with our neighbouring sub-continent, and it is useful to mention here that Science Policy constitutes one of the agreed projects for co-operation.

It is my own opinion that such Scientific and Technical Co-operation Agreements should be set up on a regional basis, between countries of the Third World, with a proper co-ordinating centre.

However, since science is a social activity, closely dependent on the social framework within which it works, co-operation between nations is a necessary but not a sufficient condition for development. Scientists of each non-aligned nation must concern themselves with the socio-political forces operative in their own country as well as in the Third World They must be participants in that historic social transformation which aims to create a rational milieu, a society free from the exploitation of man by man. This is one way in which they can help to eliminate the constraints and obstacles that stand in the way of the free flowering of science and technology in the presently under-developed regions of the world.

References 1. DEDIJER, S. Under-developed science in under-developed countries. **Minerva II** 1(Autumn 1963) pp. 61-81.
2. DEDIJER, S. Ibid. 3. DEDIJER, S. Ibid.