

Special Essay

Science and *technology* as engine of national development

PROF. DR JAMAL NAZRUL ISLAM

I have been involved in research and teaching, in mathematical and theoretical physics, for almost four decades, and lived abroad for many years, over twenty years in the UK and about five in the US. I returned to Bangladesh permanently in 1984. Apart from purely scientific matters, I have some interest in social problems, national, regional and global, and over the years I have developed a certain point of view and I would like to share some thoughts, for what they are worth, with readers about some of these matters.

Let me give a brief summary. I will discuss the relevance of science and technology for development and issues such as basic versus applied science and some other aspects of education. I will talk about negative effects of science and suggestions for dealing with these. I will mention certain social problems, such as the gap between the rich and the poor, injustice in society and human conflict. An important part of this presentation will consist of extracts from writings of distinguished scientists and other prominent men, which express in various ways their views of nature and the world and such matters that are worth pondering over. Some of these excerpts, but not all, I have mentioned in my earlier writings, from which I will take the liberty of drawing other material. One of the basic themes running through the discussion will be how to promote development and enhance harmony in society to ensure a better future for all. I have no definitive solutions, but only humble suggestions.

It is truisms to say that the application of science and technology can help the developing countries to eradicate poverty, hunger and disease and raise the standard of living of the people. Thus it is well-known that modern agricultural methods can improve the yields of crops, modern medi-

cine can check the prevalence of disease, and advanced communication networks can help improve the infrastructure that is needed in administering these developments, and so on. In principle all these are possible, but in practice many difficulties arise. Lack of education, apathy, inefficiency, etc are well known obstacles to progress in any field.

In any enterprise such as the application of science and technology for development, one needs the collective and strong will of the nation, with a nucleus of highly motivated and capable individuals who are supported fully by the society, government and the nation.

Partly for these difficulties, scientific and technological development cannot be seen in isolation, but must be seen as a part of economic, political, cultural, moral and intellectual development, which are all dependent on each other.

After this brief excursion into generalities, I want to consider some more specific points, such as the question of basic or fundamental as opposed to applied science, and would like to emphasize the need to promote basic science in the Third World, as well as applied science.

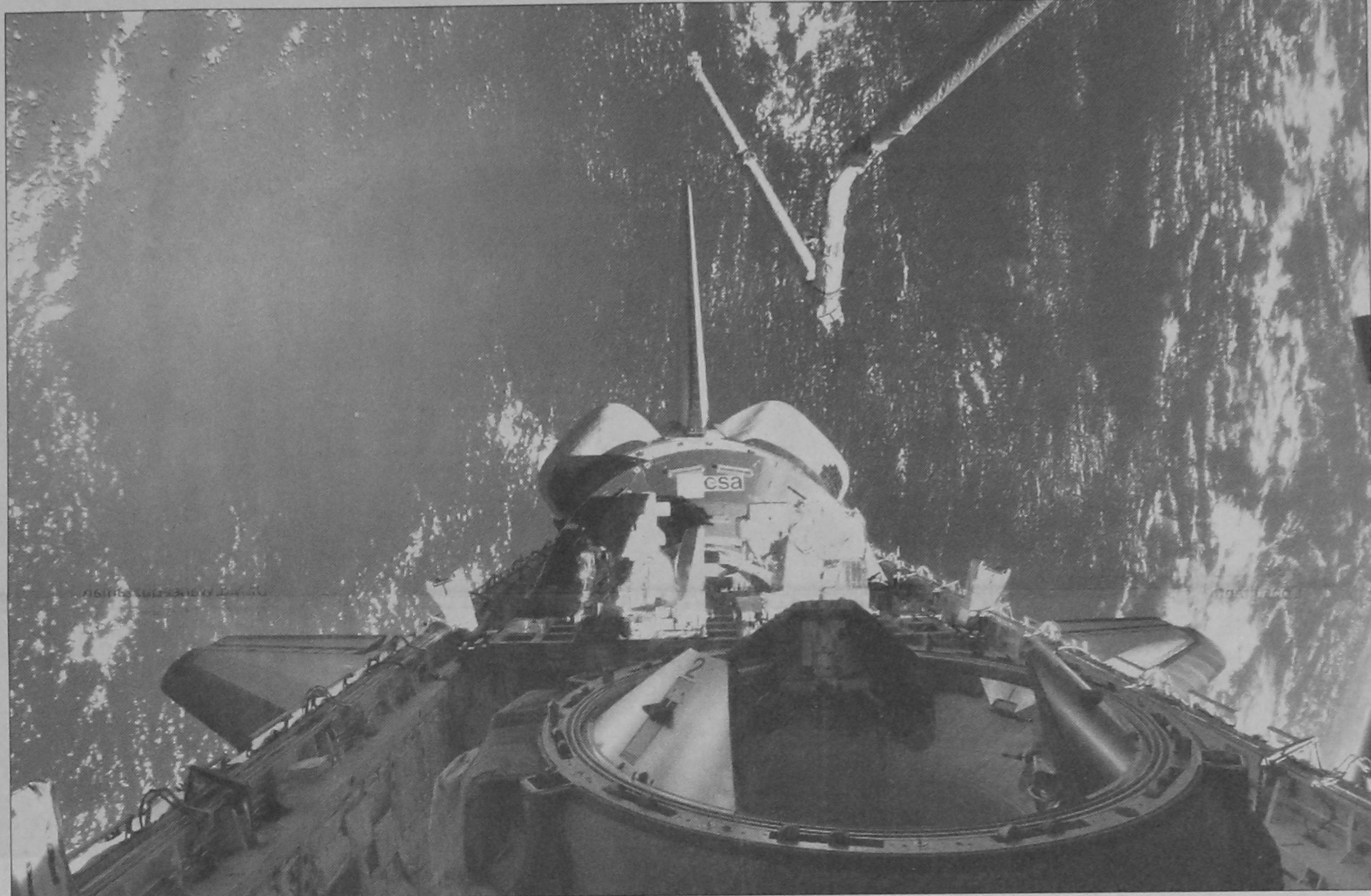
This point has been made in the past by Prof Abdus Salam, among others. In this connection I would like to quote the following portion from the Draft National Science and Technology Policy of Bangladesh published by the Science and Technology Division of the Government of Bangladesh in 1985. I believe this is still relevant today:

"While in a shattered economy like ours goal-oriented research will continue to be emphasized, a certain proportion of basic research must also be carried out in the Universities, Research and Development Organizations and other enterprises because it provides solid foundation to applied research and development. This type of research will be carried out by those with

originality and innovativeness of a high order. Successful accomplishment of basic research..... results in the creation of manpower imbued with great intellectual quality, self-confidence and the ability to find new and innovative solutions to problems."

Basic and applied science complement each other. It is sometimes said that today's basic science is tomorrow's applied science. Let me give a couple of examples of the connection of basic with applied science. We use various forms of energy in our daily life, such as electricity in households. This is usually produced by some fuel, which produces energy through chemical reactions (such as burning) in which the outer electrons of atoms take part. An atom consists of a nucleus made of neutrons and protons, around which the electrons revolve. The nucleus is small and tightly bound, the electrons move in large and loosely bound orbits. The mass of the atom resides essentially in the nucleus, but the diameter of the atom is about a hundred thousand times larger than that of the nucleus. In one centimeter one can place about a hundred million atoms next to each other. Now it takes about a million times more energy to detach a neutron or a proton from the nucleus than it does to detach an electron from the atom. From this basic scientific fact we can surmise that from the same amount of suitable material one can get about a million times more nuclear energy than fuel energy. Of course production of nuclear energy must be made cheap and completely safe, problems which have been partially solved and are being considered both by theoretical and experimental physicists.

The second example is so called superconductivity. It has been known for many decades that if the temperature of some metals is lowered below a certain point, the electric resistance disappears almost completely, which is then called a state of superconductivity. Until 1986 the temperature of the superconductors was fairly low and not so useful practically. In the last decade new superconductors have been found with high room temperature. If this trend continues and if superconductivity can be created at ordinary room temperature, this will have enormous significance for the energy industry, because one will be able to send electricity over vast distances at much reduced cost. The theoretical explanation of high temperature superconductivity is a difficult problem; the person who finds the answer will be fortunate. The scientists who found the phenomenon experimentally (Prof. G. Bednorz



and K. A. Muller) were awarded the Nobel Prize.

Basic science is used increasingly in modern engineering. In many engineering projects the leaders have to know not only some basic science, but also economics and some social science. A writer makes the following comment about modern engineering:

"The need for men who can view engineering, wide and complex as it is, as a single field of operation with relatively few basic laws and methods is increasingly recognized. Such men can work well with people from other disciplines and, when they gain sufficient experience and judgment, can successfully plan and direct vast enterprises."

The importance of basic theoretical understanding in practical applications emerges also in the work of John Maynard Keynes, one of the leading economists of the century. In the preface of his famous book, *The General Theory of Employment, Interest and Money*, he says: "This book is chiefly addressed to my fellow economists. I hope that it will be intelligible to others. But its main purpose is to deal with difficult questions of theory, and only in the second place with the applications of this theory to practice."

Notwithstanding the emphasis on theory, or perhaps because of it, the book has had an enormous influence.

One of the obstacles to good scientific research in Bangladesh as in many Third World countries is the poor quality of science education in schools and colleges. There is little effort to impart to the students a true understanding of basic scientific principles. The students are not encour-

aged to find out and work out things by themselves they usually get the material by heart and reproduce it in the examination. This reflects the poor quality of the teachers themselves. I believe if the teachers are exposed to a modicum of basic scientific research, this will improve the quality of their teaching, thereby contributing to good science education in schools and colleges.

The M. Phil. degree is particularly suitable for Bangladesh as there are many college teachers and some university teachers for whom the Ph. D. degree, for various reasons, is not suitable, whereas they are quite capable of or could avail of doing an M. Phil. degree and would benefit greatly from doing it. At the same time, an attempt should be made, wherever possible, to introduce and maintain a Ph. D. programme. The attainment of a Ph. D. degree by a member of a university department or any institution should be looked upon as a cooperative achievement of the whole institution which, apart from personal advancement of the degree holder, enhances research and academic activities generally, and contributes to a basic function of any academic institution: the pursuit of truth and knowledge for the benefit of society and of mankind.

In Bangladesh, because of various problems that have arisen in state educational systems, private universities and colleges have a role to play in education. However, I believe the bulk of mainstream education, at all levels, must be provided by the state. The following excerpt from Adam Smith may be relevant (quoted by Amartya Sen in his *Development as Freedom*) in which he expresses "his frus-

tration at the parsimony of public expenditure in the field of education":

"For a very small expense the public can facilitate, can encourage, and can even impose upon almost the whole body of the people, the necessity of acquiring those most essential parts of education."

Private colleges and universities can play an important supporting role to state institutions. Both state and private academic institutions should be under the "umbrella" of some central authority such as the Ministry of Education and the University Grants Commission, and there could be regular meetings and discussions to create and maintain an appropriate balance. An important aspect is that private academic institutions should be conscious that they exist not just for an affluent section of society, but they should make every attempt to be of genuine service to the whole academic community and society by providing scholarships to indigent students, library facilities to all students and interested public, holding regular seminars on matters of general interest, etc. There are, of course, financial constraints and some of these activities may be taking place already, but these considerations may be kept in mind. I am sure efforts are being made in this direction, but further steps could be taken to make the cooperation between state and private education sectors more effective and meaningful.

As regards M. Phil. and Ph. D. degrees, the Ministry of Education, the Ministry of Science and Technology, the University Grants Commission

