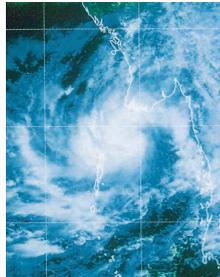


LOOKING AHEAD

Considering the size and multitudinous problems, India has made significant progress in several spheres: agriculture, irrigation, atomic energy, space, information and communication technologies and science education. To ensure ecological security, provide safe drinking water, better health, employment, peace and equity, we have to utilize science and technology more effectively. In this section a foremost and passionate practising scientist of India reviews the advances and suggests the need for a strategy for the future, using the combined strength of science and socio-economic sectors.



CHAPTER XXXVIII

LOOKING AHEAD

PROLOGUE

When we gained independence in 1947, we had the faith that the country will emerge to be a progressive country, which was economically sound and where social justice prevailed. As articulated by Mahatma Gandhi, true freedom meant wiping out hunger, poverty, unemployment, bridging the gulf between the rich and the poor, banishing communal strife and ensuring that millions of Indians participated in nation building. These hopes were enshrined in our constitution as well. Our constitution under the Directive Principles of State Policy states : *The State shall, in particular, direct its policy towards securing (a) that the citizens, men and women equally, have the right to an adequate means of livelihood; (b) that the ownership and control of the material resources of the community are so distributed as best to subserve the common good... (article 39). The State shall endeavour to provide, within a period of ten years from the commencement of the constitution, for free and compulsory education for all children until they complete the age of fourteen years (article 45). The State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties... (article 47). The State shall endeavour to organize agriculture and animal husbandry on modern and scientific lines... (article 48).*

India is one of the few countries which recognized, from the very beginning, the importance of science in national development. *The Scientific Policy Resolution* moved in the Parliament on March 4, 1958 by Jawaharlal Nehru, clearly states that we have to secure for the people of the country all the benefits that can accrue from the

acquisition and application of scientific knowledge.

It is universally accepted today that the use of scientific knowledge has improved the quality of life all over the globe. This great benefit to humankind is exemplified by the increase in life expectancy, increased agricultural output and availability of cures for many of the diseases. The myriads of scientific discoveries and technological developments have indeed affected humankind in a big way. We in India have had scientific traditions for centuries, and the application of modern scientific knowledge has helped us to overcome many difficult problems. For example, the agricultural revolution and the eradication of smallpox and control of many other diseases have brought in considerable relief to our population. Today, we are not only self-sufficient in food, but have also performed well in the production of milk, vegetables and fruits. Wherever our scientists have been assigned well-defined tasks, the results have been truly remarkable. Our accomplishments in atomic energy and space being typical instances. In the last 50 years, we have built a number of scientific and educational institutions and the country has considerable technical personnel.

Despite the progress made in the last five decades, the country still faces many challenges. We have a high percentage of illiterates, and diseases such as malaria and tuberculosis continue to plague our people. Safe drinking water is not available in large parts of the country. Malnutrition is rampant and is affecting the physical and mental growth potentials of our population. Clearly, there is a need for more effective utilization of science and technology for the

progress of our nation and for improving the overall quality of life of our citizens. We require planning for science, and science in planning. We should recognize, however that solutions to the various problems faced in the country do not depend on science and technology alone. There is need for political will as well as proper organization and planning in the socio-economic sectors.

The need to integrate socio-economic planning with science & technology planning has been stressed over the years. The first meaningful effort in this direction was made by the National Committee for Science and Technology (NCST) during the 1970's. The NCST prepared the first science & technology plan with an agenda for action. Since then, there have been other bodies, in particular the Science Advisory Committee to the Cabinet (SACC) and the Scientific Advisory Council to the Prime Minister (SAC-PM) which have attempted to draw up programmes and plans for science and technology in the country. Much of what has been said in the approach papers and other documents produced by these bodies continue to be relevant today. While there has been some success in integrating science & technology planning with socio-economic planning, there is still much to be done. Many important scientific bodies such as the Science and Engineering Research Council (SERC) owe their creation to NCST. SACC was responsible for establishing the Departments of Biotechnology and Ocean Development. A technology policy was also formulated during the 1980's by SACC. Important structures such as the Technology Information Forecasting and Assessment Council (TIFAC) were established by the SAC-PM and Scientific Adviser to the Prime Minister during 1985-89, when many important national technological missions such as drinking water and universal literacy were launched.

Sustainable livelihood is the important need of all our citizens. While planning for science and technology (S&T), therefore, we cannot forget that we have to justify the trust placed by the society on the scientific community. The society should have a reason to support science in the country and it is

important to demonstrate the effective role of science in improving the conditions and standards of living specially of the underprivileged. In such planning, we must consider the various possible development alternatives and adopt such policies and programmes as would promote sustainable development. Instead of following beaten paths defined elsewhere, the Indian situation has to be the main guiding force. Such an Indian approach to development is necessary to reduce unemployment and ensure social justice. We have to play a significant role in the major revolutions of this century such as the gene revolution, materials revolution, information technology and communications revolution and ecotechnology revolution. With well-directed efforts, it should indeed be possible to improve the overall quality of life of our people in the near future. In what follows, we briefly examine some of the dimensions in planning S&T in this vast democratic country. I deal with the infrastructure needs first since they are essential for the development of both urban and rural India.

INFRASTRUCTURE REQUIREMENTS

A serious problem that we face in making national development plans relates to infrastructure in all its aspects. Infrastructure includes the core sectors of energy, transportation, communications and education.

The relationship between energy and population is conditioned by factors such as economic growth rate, demand for food, changes in living conditions, availability of technologies and capital. We have to evolve a proper energy policy wherein we define how the country should make use of the different sources of energy. We have not adequately made use of alternative energy sources, in particular solar energy. India should be a leader in solar energy research, and this requires special attention. There is a need to adopt an energy strategy which would have a high priority for development of renewable sources of energy as well as for energy conservation and efficient use.

The future demand for transportation will be governed by several factors which include income

growth, energy supply, urbanization, environmental norms and pressures from rural and remote areas. The need for much better public and intermodal transportation systems will acquire increasing importance. Our roads and railways will have to be able to satisfy the increasing demands of industry and society, particularly for the transportation of food and other goods. An air transportation strategy using medium-sized aircraft should be considered as a means of travel to isolated places.

There is much to be done in obtaining the full benefits by the use of modern information technology. It is not only useful as a means of communication among institutions and people, but also as a means to integrate the country. We have to network all our scientific, industrial and educational institutions. A proper communications facility would give greater confidence to people in rural India and empower them in the true sense. The new information technology policy of the government addresses many of the current concerns.

Education is an integral part of the infrastructure. Without a proper education base, no plan can succeed. In addition to the eradication of illiteracy, inculcation of scientific temper amongst the masses should get priority. A proper scientific awareness will trigger the participation of a majority of our citizens in the development process and enhance their ability to tackle new situations. Facilities in educational institutions need immediate attention. Strengthening the education sector will give us a strong knowledge base which can be directly utilized to create wealth. It is necessary that the allocation for the education sector is at least doubled reaching 6% of the GDP in the next year or two. A sound policy for allocation of funds to different aspects of educational development is needed. It is essential that there is parallel progress in the primary and the higher education sectors.

PRESSING PROBLEMS

While several kinds of efforts in science & technology are required today, the most important of them are those addressed to the solution of the pressing problems of society. These include popula-

tion, food, shelter, health and nutrition.

India's population is expected to be about 1,500 million by 2050 and the problem of food security in the country may become serious in the years to come. It is likely that we will have to produce around 350 million tonnes of food by the middle of next century. The increasing population will exert severe pressure on land, forests and water resources. If we continue to use these resources at the present rate, there can be a large gap between food grain production and demand. A new approach to resource management is obviously necessary.

Although provision of shelter for the people is enshrined in our constitution, it has not received the attention it deserves. The estimated shortage of housing in 1990 was about 30 per cent of the need. The living conditions are far from satisfactory. Nearly 40 per cent of our population live in one-room tenements and another 30 per cent in two-room dwelling units. Only 75 per cent of urban and 30 per cent of the rural households receive electricity. Initiatives are needed to correct these major deficiencies.

The health of a person is largely dependent on the nutritional input. Nutritional inadequacy arises either due to poverty or environmental degradation. Undernutrition and malnutrition also contribute to mortality rates. Malnutrition and maintenance of health pose serious problems, particularly in the rural parts of the country. There are many diseases unique to India which demand considerable research effort.

Health care and services play a significant role in population control, just as education and economic well being. Nearly 70 per cent of the public sector outlay for health is spent in urban areas, where substantial private sector facilities exist. The nature of training and technology required for health care in rural areas would require a totally different approach than what prevails. Careful thought has to be given to find ways to exploit our strengths in indigenous forms of medicine, instead of total dependence on the western system.

COMPETITIVENESS

Besides tackling the pressing problems of the society and those related to infrastructure, science and technology have to be fully exploited to make the country competitive. The technology base of the Indian industry has to be significantly improved and innovation has to play a greater role in our industry. The art of transforming knowledge into wealth has to be learnt by all concerned and this can happen only when we fully appreciate the role of the knowledge-base. Industry has to invest considerably more on R&D, innovation and manpower training. There has to be emphasis on engineering design and in the accumulation of intellectual property. Greater attention has to be paid to knowledge-based industry where India can become a world leader. For example, in the software area our aim should be to get around 4-5% of the world business.

Long-term planning in technology has severe limitations. It is important to be vigilant about new and unexpected developments in technology and the likely areas in science that are expected to yield path-breaking technologies. Support for fundamental research is important because new technologies will be based on science at the cutting edge. Unless we are leaders in science, it is unlikely that we will be competitive in technologies of the future.

The recent trend when young people are mainly attracted to business and banking has to be reversed. Young talent has to be attracted to take up careers in science and engineering.

The Government has to take the major responsibility to support S&T as well as higher education in the country for some years to come. Industry may eventually help in this direction, but this will take some time. The Government has a crucial role in this transition period. In order to sustain the existing talent and for inducting new capabilities to meet new challenges, there should be a clear declaration of support for science and technology. Such a policy commitment should be demonstrated by increasing the present level of

support of science from around 1% of the GDP to 2 or 3% within a time frame.

Successful scientific efforts in the country have resulted when the programmes have clearly defined targets and there is autonomy and accountability. They have also demonstrated the positive effects of multi-institutional linkages. These factors should be kept in mind when supporting scientific research.

EPILOGUE

In conclusion, renewed efforts are required in areas of national priority where science and technology should play even a greater role. It is not difficult to achieve a consensus on priority areas such as food security, housing, health and nutrition, energy security, transportation, communications, education and information technology. For each of these priority needs, specific goals, time-bound targets and programmes have to be defined with a sense of urgency. For example, we should be able to remove illiteracy, malaria and malnutrition in the next ten years. Because of the increasing competition as well as increasing population, we will face even bigger challenges in the years to come. We should become economically strong by the year 2020 by ensuring food security, a balanced energy economy and leadership in chosen sectors of science, technology and industry. There is talent in the country to accomplish the targets, and all that is needed is to give a direction to our efforts and to motivate people to take up the tasks.

What has been said above applies equally to most of the developing countries. The next 20 to 30 years will be a trial period for all of us and we have no choice but to move forward. Let us forget our differences and concentrate on the common good, and the well-being of all our peoples. While north-south cooperation is important, south-south cooperation will be of even greater significance in the years to come. There will be many problems and difficulties in accomplishing our tasks, but WE SHALL OVERCOME !

An Academy of Science can do a great deal by educating public opinion, undertaking particular problems, and bringing out scientific workers in various fields for discussion and cooperative research. But the main function of the Academy should be towards cultural improvement by contribution to human knowledge.

- Meghnad Saha