IMPORTANT INSTITUTIONAL HISTORY

SCIENCE POLICY IN INDIA

A. RAHMAN
Director
NATIONAL INSTITUTE OF SCIENCE, TECHNOLOGY & DEVELOPMENT STUDIES
HILLSIDE ROAD, NEW DELHI 110012

SCIENCE POLICY IN INDIA

Circa 1983

A. RAHMAN
Director
NATIONAL INSTITUTE OF SCIENCE, TECHNOLOGY & DEVELOPMENT STUDIES
HILLSIDE ROAD, NEW DELHI 110012

PRINTED BY INSDOC, NEW DELHI-110012

SCIENCE POLICY IN INDIA*

A. Rahman
Director
National Institute of Science, Technology & Development Studies
Hillside Road, New Delhi 110012

INTRODUCTION

The conceptual framework and the philosophy of India's Science Policy was clearly enunciated by the Scientific Policy Resolution passed by the Indian Parliament 25 years ago, on 4th March, 1958. The evolution of India's Science Policy has to be seen in terms of the objectives laid down in the Resolution, implementation of recommendations and latter's assessment from time to time.

Scientific Policy Resolution was both a testament of faith in science and a Vision of Society. Through science, the country had hoped "to secure for the people of the country all the benefits that can accrue from the acquisition and application of scientific knowledge". The gains were not to be only material but also spiritual and cultural – aimed at transformation of the outlook of people as well as society.

It aimed to provide a new strength to the scientific community and challenged them to take upon themselves new responsibilities, beyond their professional domains, to act as *avant grade* of a new intellectual and social renaissance of the country.

The government in pursuance of the Scientific Policy Resolution took steps to establish institutions for education and research, and created conditions which could promote science and technology and the implementation of results of research. It provided guidance, by directing the attention of scientists to some of the critical problems in society for which science and technology could provide an answer. It invited scientists to deliberate on the progress of policies and their implementation, to lay down the lines of possible further development.

It is essential to have a look at the developments which have taken place so far, particularly in view of the changes in outlook of science itself, brought about by the rapid developments in science and technology and

*Views expressed in this paper are of the author and not necessarily those of organisation

their impact on man, society and environment. The way societies have used the results of science and technology, which have benefited only a small section of population, the distortions caused by the pursuit of profit or the increasing misuse of science and technology for creating weapons of destruction are disturbing. These developments have raised doubts in the minds of many about the role of science and technology in the promotion of a welfare society. Further, questions have also been raised at the increasing centralisation of production system, based on utilising non-renewable resources and using large quantum of energy in the production system.

Besides the above, the general euphoria which was created soon after World War II that science and technology would solve every problem by providing a technological fix has disappeared. In addition, there is a growth of a general climate in societies which seem to disregard, if not discard, what goes in the name of scientific outlook. A large number of cult movements have appeared and spread all over the world which challenge the method and outlook of science and have a large following.

Science is not a dogma. In contrast to other systems, it is a self-correcting system. Each development in knowledge not only enlarges our understanding of phenomena but also help us to see things in a different perspective. The process of acquisition of knowledge and formulating theories based on it is a dual process - of the acceptance of the new and the rejection of that which is not in conformity with known facts. Societies which aim to base themselves on scientific knowledge have to be dynamic societies, changing and adjusting themselves to new knowledge. The framers of of Scientific Policy Resolution and the Parliament which endorsed the spirit of the Resolution had wished India to be such a dynamic society. Have we become so?

The last twenty five years have been years of growth and development of many achievements and also of many failures and it would be worthwhile to have a look back and assess the overall development and the direction of these developments.

This paper presents the evolution of the Science Policy in two parts. Firstly, the assessment of the implementation of Scientific Policy Resolution. The government called, from time to time, a number of conferences of scientists and technologists and gave various directives as a result of the assessment of steps taken and implementation of decisions – in other words, the internal factors of the scientific system which lead to a series of changes and developments in science policy. Secondly, it aims to give a bird's eye view of the development of Science Policy as a result of overall development and pressures generated by society and the compulsions of social, economic and political developments within the country and outside. In other words, it also endeavours to indicate the impact and the resultant changes in Science Policy as a result of external factors.

REVIEWS OF SCIENTIFIC POLICY RESOLUTION

The passage of Scientific Policy Resolution led to the holding of the conference of scientists and educationists by the Government on 19th July, 1958 to identify tasks involved in the implementation of the Scientific Policy Resolution and to work out a plan of action.This was followed by the second and third conferences which were held in 1963 and 1970. In between these two conference, a round table of young scientists was called in 1967 by the Prime Minister to discuss critical issues relating to the development of science and technology in the country. The salient points of these conferences are presented.

First Conference

The Government of India organised the first conference of Scientists and Educationists under the auspices of Ministry of Scientific Research and Cultural Affairs in 1958 to consider the ways and means to implement the Scientific Policy Resolution. The Conference made the following recommendations :

i) The scales of pay and service conditions of scientific and technical personnel employed in various R&D and teaching establishments should be rationalised. The service conditions should be made comparable to the superior administrative services so that the best brains were attracted to the professions of scientific research and teaching.

ii) The search for scientific talents should be started at the higher secondary school level through a suitable machinery to select and place bright students in appropriate institutions. Fifteen to twenty per cent of the deserving students admitted to universities should be given scholarships.

iii) Adequate equipment, apparatus and other assistance, such as laboratory, library and clerical facilities, should be provided to research workers.

iv) A large number of fellowships at postgraduate and doctorate levels should be instituted to encourage talented scholars to take up research as a profession.

v) Trained scholars should be absorbed in suitable jobs and positions.

vi) Close collaboration between the R&D and teaching institutions should be encouraged.

vii) Rapport should be built up between industry and government departments to draw upon the technical and scientific talents available with the teaching and research organisations, for employment as consultants without taking them away from their parent organisation.

viii) Suitable machinery should be evolved to enable young research work-

ers to be transferred from one institution to another in order to make use of their expertise.

ix) Measures should be taken to intensify the popularisation of science through various audio-visual means.

x) Efforts should be made to provide facilities for the manufacture of instruments and scientific apparatus required by schools and colleges.

xi) A central institute should be set up to serve as a clearing house for scientific and technical information from all the sources – national and international.

Second Conference

The second conference of Scientists and Educationists was organised during 4-5 August, 1963 to further review the implementation of the Scientific Policy Resolution and review the progress of the tasks identified at the first conference. The review revealed that the tasks indicated were completed since the first conference.

The scale of pay in the universities, technical institutes, and scientific departments were enhanced. The scheme of merit promotion and advanced increment was introduced in a number of scientific departments for outstanding research workers. Six eminent scientists were appointed national professors in geology, medicine, physics and indology. The implementation of the scheme of research for scientific talents at the school level by the State Governments was, however, not successful, in view of shortage of funds. National Council of Educational Research and Training initiated this scheme in the Union Territory of Delhi and intended to extend to other States gradually

The University Grants Commission enhanced the grants-in-aid to various universities with a view to providing them research and library facilities. Similarly,the financial support to scientific.institutes and societies was considerably increased. A large number of research scholarships and fellowships were instituted by the CSIR and UGC at the universities. In addition to the largest number of scholarships initiated by the CSIR at the universities, it also provided considerable resources to the universities by way of project grants, to undertake research. The Scientists' Pool was created in CSIR for the temporary placement of highly trained scientists in India or those who were working overseas to enable them to work in the universities or national laboratories until such time as they are able to find suitable employment. Supernumerary posts were created in scientific research institutions and public undertakings to absorb such scientists in these institutions.

In the rural areas, Vigyan Mandirs were set up to popularise science amongst the people. These Mandirs were provided with projectors, slides and other simple scientific apparatus and equipment to demonstrate to villagers

the benefits of scientific methods in their daily life. Vigyan Mandirs had a nucleus of libraries and museums. Science clubs were also arranged through Vigyan Mandirs, Forty Vigyan Mandirs were established.

Some of the tasks which could not be implemented :

The scarcity of foreign exchange remained the main stumbling block in equipping research establishments.

The exchange of scientific personnel among the research institutions, universities and industry for a limited period could not be accomplished due to practical difficulties requiring reformulation of rules and regulations for such an exchange as well as due to certain basic facilities, such as housing and education.

Scarcity of textbooks and their standard affected the quality of education. Further, no serious attempt was made to produce books in different languages of the country, affecting the dissemination of science amongst the people.

For the first time, a separate chapter on Science and Technology was included in the second Five Year Plan. The total provision for scientific research increased from Rs.150 million to Rs.400 million in 1963, as a result of which the facilities for education and research expanded. However, the second conference of Scientists and Educationists noted that the progress made was far behind the realisation of the goals set in the Scientific Policy Resolution. It was noted that financial allocations for scientific research and technical education were inadequate. The scientists were equally disappointed in the provision of meagre foreign exchange for equipment and books. There was an expression of dissatisfaction with regard to the cooperation between the universities and national laboratories, mobility of scientists and application of the results of scientific research, and the organisational environment for creative research. In conformity with the spirit of Scientific Policy Resolution, the conference made the following recommendations :

i) Allocation for scientific research should be roughly one per cent of the total national income.

ii) The research work should be project-oriented and measures be taken to ensure the economic utilisation of the research projects.

iii) Priorities in scientific research programmes should be related to the industrial priorities.

iv) Postgraduate departments of various universities and Centres of Advanced Study in various fields of science and technology should be established to ensure an adequate supply of scientists.

v) The structure of scientific services should be simplified to ensure greater mobility and internal democracy promoted to achieve optimum conditions for creative work.

vi) Efforts should be made to maintain collaboration between the laboratories and users to encourage greater exchange of personnel between them. The users should be associated with the laboratory from the very beginning of formulating the programme.

vii) Indian processes should be given preferential treatment by providing greater scope for indigenous design and fabrication of equipment and development of consultative industrial advisory services. In areas where indigenous know-how did not exist, the imported processes should be utilised to build up and develop indigenous know-how.

Round Table of the Scientists & Technologists

Around 1966, most of the infrastructure for scientific and technical research was completed. Indian science had reached a level from where it could begin to contribute substantially to the socio-economic development. Though scientific research became a significant sector claiming financial and man-power resources yet its activities could not respond to meeting the socio-economic needs as was expected of it. The consequent inability of the indigenous R&D institutions to create an impact on society, particularly by promoting industrial development, led to an intense public discussion on the performance of science in the country. The question pertaining to management of research, availability of resources and their utilisation, research environment, commitment of scientists and technologists for the application of indigenous research, import of know-how, linking of scientific research programmes with social needs, organisation of science and the government policies were debated by the scientific community as well as by the public.

The Prime Minister called a Round Table Conference of Scientists and Technologists which was held during 7-8 September, 1967 for discussions on science, with a view to identifying problems and search for their possible solutions. Fifty scientists and technologists were invited from CSIR, AEC, TIFR, DRDO, ICAR, ICMR, Universities, private industry and the Planning Commission. The view was overwhelmingly expressed by the participants that very little had been done to implement the Scientific Policy Resolution. The major issue discussed related to creation of scientific temper, planning of science and dissemination of information. The conference made various recommendations to overcome the problems in these areas, the chief amongst them were :

i) Scientists in universities and laboratories should take part in school science education. They should establish contacts with the local educational authorities in advisory capacity.

ii) An important step in developing a scientific temper in the country would have been rationalisation of national decisions based on available information and taking into account economic, social and technological factors rather than parochial or other pressures.

iii) Efforts to be made to disseminate and popularise science through documentary films, radio, television, popular science journals and magazines, etc.

iv) The universities should build viable groups in selected areas. The scientific personnel and equipment, whether located in universities, laboratories or industries, should be available freely for teaching, research and other scientific activity irrespective of their location. No institution should have a static staff structure which is insulated from outside environment. Provision of joint appointments for national laboratories and universities should be encouraged.

v) Every possible effort should be made to induce Indian scientists to return to India. Efforts should be made to spot out the scientists of excellence, and those who really want to return, conditions be created to absorb them in worthwhile scientific activity in the country.

vi) A machinery for planning of science and technological efforts should be developed.

vii) The Scientific Advisory Committee to the Cabinet should be continued but it should be strengthened through the induction of a full time Chairman and a small permanent supporting staff.

viii) A National Council for Science and Technology should be set up to perform the overall function for coordination and planning of scientific research at national level.

ix) Suitable machinery should be set up to pursue the implementation of Scientific Policy Resolution.

x) Special efforts should be made to recognise scientists and technologists making contributions to applied sciences.

xi) Efforts should be made to build up a rapport between industry and national laboratories till the industry starts its own research facilities, and national laboratories may help in nurturing such research.

xii) In cases where know-how of a high standard could be developed within the country foreign collaboration was undesirable. Foreign collaboration may be resorted to, for the purpose of gaining lead time.

Third Conference

The third conference of Scientists, Technologists and Educationists was organised uner the auspices of the Committee on Science and Technology during November 28-30, 1970. The principal objectives before the conference were to make a comprehensive review of the progress made in the implementation of Scientific Policy Resolution; to suggest in the light of this review, measures to remedy any lacunae observed in its implementation; to consider whether there was any need for restatement of Scientific Policy Resolution in order to incorporate a policy for technology, and if so, to suggest necessary modifications.

The progress report on the implementation of Scientific Policy Resolution during 1958-68 was presented by the Committee on Science and Technology (COST). It brought out that the expenditure on R&D increased from 0.21 to 0.43 per cent of GNP during the period under review.The facilities for R&D were strengthened in the scientific institutions.New Institutes, laboratories, centres and stations were established under various scientific agencies and departments. The activities of the Scientific Surveys were strengthened and expanded. There was considerable expansion of the facilities for higher education in science, agriculture, technology and medicine. Besides, the enrolment in science courses at university level increased four-fold. The outturn of scientific and technical personnel at graduate and post-graduate levels for different fields of science increased three-fold. The number of scholarships and research fellowships were increased to encourage students to undertake advanced studies and research in various fields of science and technology. Training courses were started by the Department of Atomic Energy, Ministry of Defence, and Research Design and Standards Organisation (RDSO). The Inventions Promotion Board was set up to encourage the inventive talents of the people.

Some of the old problems, however, continued. For instance, the state of the utilisation of the indigenously developed know-how remained poor. The industry continued to show lack of interest in indigenous research capabilities, even though the contribution of indigenous scientific research could have been considerable to the industrial sector. The public and private production units did not take advantage of national R&D capabilities despite the fact that those units concerned with mining and production of minerals including coal and oil, thermal power, iron and steel, fertilizers, heavy equipment, synthetic chemicals and polymers,etc. were working far below their rated capacity and suffered successive series of breakdowns. There was much left to be desired to create conditions for useful communication between R&D institutions and industry. For instance, most of CSIR laboratories had facilities for basic oriented and applied research but not for development. Pilot plants,design, fabrication and engineering facilities being critical factors in path of technology transfer, could not be developed unless the industry took interest and shared substantial expenditure of development.

There was need for a uniform recruitment policy as well as service conditions in all the scientific institutions. The factors inhibiting the mobility of the scientists continued to operate. The problem of younger scientists being encouraged to participate in the decision making process also was ignored. Unemployment among the scientific and technical persons continued.

Two steps were suggested to ease the unemployment situation. Firstly, it was suggested that the large number of posts lying vacant in the research, academic and technical institutins should be filled up. Secondly, policies were evolved for the self-employment of the technically trained persons.

The Conference made recommendations to obviate bottlenecks in the implementation of various measures arising out of the Scientific Policy Resolution. The important recommendations were :

i) A National Council of Science and Technology (NCST) should be set up to formulate a science plan, and to establish firm links with the Planning Commission. The national plan for science and technology should be integrated with the economic plan.

ii) Planning and Programming units should be set up at various levels with experts in planning, programming, system analysis and operational research.

iii) Evaluation of the national science efforts should be undertaken at all levels and should include an assessment of costs and benefits. Scientific programmes should be evaluated or reviewed periodically so that the priorities are always current.

iv) The existing system of selection through UPSC should be abolished and a system of recruitment based on talent hunt should be evolved by the agency or laboratory. The salary structure for scientists should be commensurate with their responsibilities and also adequate to attract the best available talent in the country. The service conditions including retirement benefits should be uniform.

v) A suitable policy for import of technology should be evolved. Policies to encourage R&D in the industry and its greater utilisation should be formulated.

vi) The distinction between scientific and technical personnel should be removed to encourage scientists to undertake applied engineering, pilot plant, techno-economic manpower survey and liaison work and to promote mobility between different kinds of activities.

vii) Manpower planning should be integrated with overall national planning of goals and priorities. Exchange of personnel between universities and national research establishments should be encouraged and the possibilities of joint programmes between universities and national laboratories should be exploited.

The setting up of the National Committee on Science and Technology (NCST) in 1971 was an important step towards systematic planning of science and technology for development. As a first step, it brought in, in 1973, a policy document entitled "An Approach to Science and Technology Plan". The approach spelled out the objectives of meeting minimum needs, achieving technological self-reliance, maximising the utilisation of existing scientific and technological resources, developing human resources, generating employment opportunities of matching of supply and demand of science and technology. On this basis, the NCST undertook the major task of for-

mulating the nation's first S&T Pl in which about 2000 scientists, technologists, social scientists, and technical personnel belonging to various ministries participated. The S&T Plan was dovetailed with the Fifth Five Year Plan. This marked a watershed in the consciousness of the scientific community and the decision-makers for planning science and technology.

This brief and cursory account of the follow-up action of the Scientific Policy Resolution indicates the response of the government to the developing situation and the initiatives taken to meet it. However, it also reveals the lack of machinery for continuous monitoring the progress of implementation of various decisions taken from time to time, and the development of a feedback system to the decision making system.

The major shortcoming which affected the development of R&D to meet specific social and economic needs of the country lay in the lack of linking of the R&D institutions with industry. In the import of technology, insofar as the choice, terms and conditions and further development of technology was concerned, the R&D institutions were neither consulted nor involved. Efforts made from time to time to develop a clear cut-policy - to have a technology policy resolution - could not fructify till 1983. The efforts to build up linkages and to involve the laboratories in decision making regarding import of technology were also nullified under various considerations and pressures.

One of the reasons, which affected the situation considerably, was the attitude of scientists themselves - their preoccupation with their research problems, without taking wider issues into consideration. Their isolation from industry as well as from other sectors involved in the decision making system, made them ineffective as a factor which could influence the general trend. As a result of the latter, they, at no point of time, could generate sufficient pressure on the decision making system in favour of their point of view, against indiscriminate import of technology.

SCIENCE POLICY AND PLANNING OF RESEARCH

INTRODUCTION

The importance of science was recognised by the leaders of the country much before India achieved Independence. In 1939, Indian National Congress appointed a National Planning Committee under the Chairmanship of Jawaharlal Nehru and invited leading scientists to participate in the formulation of plans of economic development and social betterment. A study group dealt with the problem of general and technical education and scientific research. Besides other recommendations, this Group also suggested that the programme of industrial and educational development should be closely linked with the programme of scientific research. This line of approach was continued with greater vigour and concentration in the context of specific situation. It was clearly stated in the Scientific Policy Resolution of 1958 of the Parliament.

The evolution of Science Policy in India is interesting from many points. At each stage of development of India, since Independence, specific goals were met. When these were reached, or partially achieved, or when they posed new sets of problems they were reviewed and a new direction was given. In addition, the economic and political developments also brought to surface a set of needs. Science policy evolved as a result of interaction of the two, i.e. internal development of science and technology and economic political needs. It must, however, be emphasized that the political leadership played a decisive role in assessing the development of science and technology and in directing it into fruitful channels. The active involvement of political leadership, faith in science and technology and an appreciation of its role in development is a significant factor in the development of science in India. This interaction also brought the political leadership and the scientific leadership of the country together, who came to share common interests, goals and objectives. This interaction also came to play a vital role in evolving government policies, particularly in new and emerging areas of science and technology, which required both a far-sighted and imaginative approach on the one hand and long-term and heavy investment in research on the other. It was a result of this interaction that a major thrust was provided, right at the beginning, to such areas as atomic energy, electronics, space etc. Lastly, another interesting feature of the policy was the involvement of a large number of scientists and technologists in discussions and debates on science policy and science plans at various forums.

The credit for these developments goes to Nehru who was one of the few, if not the only one, of the political leaders of the world in his time who had an abiding faith in science and the role which technology could play in national resurgence. He went so far as to say that future belongs to those who cultivate science and befriend scientists.

Nehru's strategy for the promotion of science and technology and its role in development could be summarised as follows :

a) Creating social consciousness amongst scientists, by posing social problems before them and asking them to try to find answers. This he did at various meetings he addressed, particularly at the annual sessions of the Indian Science Congress Association, which he made it a point to attend regularly;

b) Making administrators conscious of the utility of science, through involving scientists in various committees;

c) Involving scientists in the decision making process;

d) Using scientific knowledge in the reforms he proposed to undertake, as for instance, in the use of metric system and the preparation of an Indian calendar;

e) Giving support to science and technology. He spent a great deal of time and effort in creating a base for scientific and technical research,

against the opposition of industrialists, administrators and some of his partymen. As a result of his efforts, a chain of research laboratories were established under CSIR, a number of agencies like Atomic Energy were established, Science & Technology Departments of the universities were expanded and Institutes of Technology created and adequate resources provided to meet these requirements. However, when under great financial difficulties, research institutions' grants were cut, Nehru went out of the way to restore them. He called the research institutes temples of learning and wanted them to flourish fully; and

f) Promoting scientific temper. Nehru knew that science could not flourish merely by creating an infrastructure in a society which was steeped in superstition; he, therefore, made considerable effort himself, and repeatedly pointed out to the scientists the need for the popularisation of scientific outlook amongst the people. He wanted to make science and technology a part of Indian culture. He thought this to be a critical factor in the development of science and technology in India.

Evolution of Science Policy

It would be worthwhile to briefly describe the five phases through which the goals of R&D in the country have evolved. These were :

a) Creation of infrastructure for research;
b) Promotion of research aimed at import substitution and export promotion, to solve the economic problems of the country;
c) Attainment of self-reliance;
d) Science for the people; and
e) Promotion of basic research.

Infrastructure

The first phase of the development of science and technology was the establishment of infrastructure for research and development (R&D). The rapid development of different branches of science and emergence of new areas like nuclear energy, electronics, space etc. during the war, created the need to develop suitable agencies to develop these branches. Bhabha's letter to Nehru on the need for creating the finest institutions in India comparable to those anywhere in the world, which led to the establishment of the Tata Institute of Fundamental Research, clearly indicates the goals of this period. Under the same objectives, a chain of Institutes of Technology on the model of MIT in USA were created.

The three basic assumptions under which these institutions were created were :

a) The benefits from science and technology are self-evident and hence must be supported.

b) Once the infrastructure is created, it would produce results for the benefit of society; and

c) Science being international, the establishment created as a part of the infrastrucure should work in areas which are under study in Western Europe and America in order to keep abrest of them.

As was to be known later, these assumptions were not valid insofar as results of researches would not be automatically utilised. The problem of development, as was found by experience, was more complex than initially appreciated. Similarly, it was also discovered later that technology as well as science has deep social roots and to fully integrate them in society required a major effort to change the outlook of people.

In addition, there were some unexpected developments.For instance, when advanced centres of education were created it was thought that they would provide the needed highly skilled manpower for better education, research and industry. However, those who came out of the advanced educational institutions migrated to Western Europe and USA to continue their scientific life there. Even those who remained in India, or those who returned after a prolonged stay abroad worked, in order to keep contact with R&D institutions overseas, in areas of relevance to the advanced countries. This led to the reduced impact of technology and reduction of the role of indigenous R&D establishments in the generation of technology and its utilisation for the development of the country.

The policy of import substitution and export promotion was adopted during the late fifties and early sixties, when India was faced with a severe crisis of foreign exchange. In such a situation, questions of contribution of R&D institutions were raised in the Parliament. The scientific community reacted to this by reorienting their programmes to suit the goals of research, and to meet the needs of the economy. As a result of these questions and debates, a major shift in the thinking of the scientists became evident and was reflected in the R&D programmes. More and more scientists started talking and working on research programmes aimed at import substitution or export promotion.

Later, further development along these lines led to a well-defined policy of self-reliance. A clear-cut expression of these requirements and policy was available in the document. "Approach to Science and Technology Plan", a document prepared by the National Committee on Science and Technology as a basis for the preparation of the 5th Five Year Plan.

The period of the Fifth Five Year Plan was also a period of intense political changes in the country. It was marked by the struggle for power between the more conservative and radical wings of the ruling political party. This political struggle had its reflection on science policy also. The latter was reflected in the election manifestoes of different political parties for the 1970 election. As the political events sharpened the question, the

role of science came increasingly under discussion and a number of questions were raised :

Science at what cost? for whom? and for what purpose?

This led to considerable debate on the nature and character of science and technology. The debate was initiated by a paper on "Alternative Technology" presented to One Asia Assembly. The debate on the document "Approach to Science and Technology Plan" also raised some of these questions in the context of working out priorities for science and technology.The debate and the ideas generated by it led to a number of new experiments. At the initiative of the Prime Minister, Mrs. Indira Gandhi, the Indian Science Congress Association devoted its 1976 session at Waltair to the problems of rural technology. This led to considerable emphasis being given to the problems which concerned the less privileged people of society.

Support to Basic Research

The experience of using science and technology for rural development and for the uplift of the down-trodden brought to surface the fact that problems of the down-trodden and rural areas cannot be solved through the use of outdated science and technology.They,it was realised,require most sophisticated science and technology. Further, in addition to finding technical solutions, the latter require to be integrated with social conditions and economic constraints, besides requiring a proper delivery system. Consequently, the need for long-term and basic research interposing natural and social sciences was felt.

The Sixth Plan for science and technology laid, as a result, a greater emphasis on fundamental and basic research, in addition to giving attention to immediate problems and finding their solutions with available knowledge. Considerable effort was proposed to be directed to long-term problems and their solutions, by generating necessary knowledge and technological capabilities.

Further, three new dimensions also came to be incorporated in science policy as a result of past experience, new needs and new perceptions. These were connected with the problem of safeguarding environment, factors, arising out of interaction of science and technology with society and the development of an information system and its use in decision making. As a result of these perceptions,policies were evolved taking these into consideration and major changes were effected in the infrastructure of science and technology. New agencies and departments were created to undertake responsibility and promote research in newer areas of science and technology, greater resources to back research with time-targeted objectives were provided.

The phases of R&D policy in India clearly reveal two things. Firstly, the goals set for society conditioned the R&D goals. Secondly, the impetus

for changed goals was not only due to the result of internal development of science, but mostly as a result of interaction with society and it was the political leadership which took the necessary initiative.

2. Evolution of Planning

Scientific and technological research, if it is to be effective for the promotion of science and technology and utilised for the development of the country,has to be planned. Planning should not be misconstrued as an instrument of control but requires to be understood as an instrument of effecting choices and providing a direction. India was perhaps the only country outside the socialist world, which initiated a planned approach to science and technology through planning of scientific and technological research. In doing so, it evolved its own model of R&D planning. This approach can be seen from the policies evolved, as described earlier, and the thrust provided in different Five Year Plans.

The planning process as adopted in India is a two-way process – giving of broad policy guidelines from above and interaction at national, agency and laboratory levels with the scientists. Firstly, as a result of this interaction when a plan was formulated, it was then discussed with scientists at various levels, and after their reaction was taken into account, the plan was finalised. The process is remarkable as it takes into account the number of scientists involved and the size of the country. This democratization of decision making and involvement of working scientists ensures the latter's effective participation and adds to the vigour of science in the country.

The democratization of decision making with regard to formulation of national science and technology plan for science and technology was not arrived at in one step. It was part of the evolution of scientific tradition in the country since Independence. To begin with, like any other country, the formulation of the plan was limited to a few top scientists – Directors and Heads of Agencies and Officers of the Planning Commission and Ministries. However, as a result of the experience gained and pressures exerted by working scientists, the machinery for the formulation of the R&D plan of research was evolved to its present structure. The formulation of the Fifth Five Year Plan marks a real milestone in the process of democratisation of planning.

The process could be briefly stated to run as follows :

1. The Government declared its policies, guidelines and thrusts, which are communicated to research agencies and institutions.
2. Specialised panels, covering different branches of science, areas of research and development and sectors of industry are set up to prepare plan documents for respective areas.
3. The heads of agencies and Directors of laboratories are requested to

prepare their plans taking the guidelines and reports of the specialised panels into consideration.

4. The Directors, in turn, request the working scientists, specialists in different branches of science, to prepare the plan of work.

5. The plan of work prepared by different scientists and specialists, coordinated at the laboratory level, are discussed by Scientific Advisory Panels of the respective laboratories comprising scientists and technologists from universities, industries, other research institutions and officers from concerned ministries.

6. The laboratory level plans are coordinated at agency level and are subjected to another series of scrutiny by expert panels.

7. The agency plans are coordinated and scrutinised at the Planning Commission level and finalised and resources allocated.

The entire process takes about six months.

Science in National Plans

The six plans have given a significant place to science and technology. The First Five Year Plan, started in 1952, gave importance to the establishment of scientific infrastructure. It provided funds for the promotion of scientific and industrial research in the already existing institutions; Building of new laboratories; installation of necessary equipment to enable the laboratories to function; exploration and survey of resources; Utilisation of byproducts, and local resources; introduction of standardisation; and Improvement of techniques in cottage industry.

The most significant aspect during this period was the establishment of a chain of national laboratories and research institutes in essential disciplines, located in different parts of the country.

In addition to objectives indicated in the First Plan, those in the Second Plan directed efforts to strengthen the existing research facilities; coordinate the research programmes among various national agencies; link up the research work at the national level with that at regional and state levels; train and generate scientific manpower in sufficient numbers and their utilisation; and provide increasing opportunities to creative workers.

During the Second Plan Period, the Scientific Policy Resoution was announced in 1958. The Resolution clearly indicated the objective to accord a prominent place and priorities for science in the National Plans.

The emphasis in the Third Plan was to encourage basic research in universities and training research personnel and expanding the programme of research fellowships and scholarships; the development and manufacture of scientific and industrial instruments; and investment in pilot plant trials and full scale field experiments.

During the Third Plan, scientific and technological research started to make perceptible contribution to the development of the country.The growth and development trends were indicative in the method of improved farming; better health and speedier transport facilities; fruitful uses of land and water resources and generating of energy for industrial use.

A large number of management problems had come up during the Third Plan and subsequently most of the problems remained incognizable as the visible return from R&D was not considered a criterion for investment. This attracted considerable public attention. The application and commercial exploitation of a small proportion of the scientific results achieved was seriously looked into, with a view to identifying the causes for the state of affairs. The efforts in the Fourth Plan were directed to integrate industrial research with programme of industrial development; achieve greater coordination of inter-laboratory level; and evaluate research programmes periodically at different levels.

The Fifth Plan, in terms of the formulation of the machinery, made a major departure. Firstly, a document entitled "Approach to Fifth Five Year Plan" was prepared and widely circulated for comments. Further, a series of meetings were organised to discuss the document in different parts of the country. As a result, a number of comments received and discussions held at the meetings, the "Approach" document was finalised and expert panels for different areas of science and technology were formed, who submitted their plans taking the "Approach" document into account. These plans were then integrated at the level of the Planning Commission.

The change of government in 1977 had considerable consequences on science and technology due to lack of proper appreciation of science and technology by those who came to power. Their impact was felt in terms of policies, organisational changes, provision of resources and general atmosphere, leading to considerable demoralisation of scientists and technologists and even disruption of institutional structure. The concept of planning though not abandoned was reduced to mere fiscal allocation as an annual plan exercise. However, with the change of government again in 1980, science and technology and its planning was given a new fillip.

The Sixth Plan followed a different procedure. The draft plan was prepared by the Vice-President of the CSIR, who was entrusted with the responsibility by the Prime Minister, on the basis of election manifesto of the Congress Party which won the elections and wide ranging discussions with scientists all over the country. The draft document was circulated widely and discussed in a conference of 300-400 eminent scientists and technologists from different walks of life. The document was finalised by a panel of experts formed by the Department of Science and Technology, which was then discussed by the Planning Commission and a modified document included in the Sixth Five Year Plan. The S&T Plan which is integrated with the national plan has been formulated with the objective which would subserve those of the national plan during this period.

The main thrust of the Fifth Five Year Plan was removal of poverty and attainment of self-reliance. The main thrust of the Sixth Five Year Plan was growth, modernisation, self-reliance and social justice.

The investment made in different fields of science and technology is indicative of emphasis given to different areas and the relative priorities.