Chapter 24:

SCIENTIFIC AND TECHNOLOGICAL RESEARCH

While in the first five year plan attention was chiefly devoted to the building up of national laboratories and other research institutions, the primary object in the second plan is to develop the existing facilities and to bring the work of scientists in the national laboratories and of research workers in universities and oth^er centres to bear as closely as possibly upon important problems in different fields of national development. Besides research departments in 33 universities, India now has 14 national laboratories functioning under the Council of Scientific and Industrial Research, 88 research institutes and research centres and 54 associations in the Held of scientific and technological research. Important research work is being undertaken by the Department of Atomic Energy through its own research staff as well as through a number of other research institutions as the Tata Institute of Fundamental Research. The Central Government's aim has been to build up existing research institutions, expand the facilities for research and provide increasing opportunities for creative scientific work. In each field the attempt is made to link up the work of national institutions with those functioning at regional and State levels. In chapters relating to Agriculture, Animal Husbandry and Fisheries, Forests and Soil Conservation, Irrigation and Power. Development of Mineral Resources and Health, programmes for research and investigations for the second Five year plan in different fields have been separately dealt with. The object of this chapter is to give a brief account of developments which have taken place in the field of scientific and technological research during the first five plan and those proposed to be taken up during the period of the second plan.

2. The second plan marks an important stage in the industrial and technological progress of the country. In every field of development there are pressing problems which call for scientific study and investigation and the application of the results of research. It is therefore specially important to coordinate programmes of research in national laboratories and in universities and other institutions with the requirements of national planning. To assist the Planning Commission in this task a Panel of Scientists has been recently constituted.

3. The promotion, guidance and co-ordination of scientific and industrial research and the financing of scientific research projects are among principal functions of fhe Council of Scientific and Industrial Research. The Council was established in 1942, but the scope of its operations increased greatly after 1947. The administration of the Council is vested in a Governing Body, of which the Prime Minister is the President and the Minister for Natural Resources and Scientific Research, the Vice-Prsident. The Council has two standing advisory bodies,—the Board of Scientific and Industrial Research and the Board of Engineering Research. The Board of Scientific and Industrial Research advises the Governing Body on proposals relating to (1) specific research schemes, (2) scientific study in various institutions of problems affecting particular industries, (3) specific studies and surveys of indigenous resources, and (4) establishment of new research institutions. In turn, the Board is assisted by a number of research committees, for instance, for chemical research, physical research, metals research, radio research, statistics, standards and quality control, etc. Research work under the Council is carried on in its own laboratories and also at universities and other centres. All the national laboratories provide facilities for team work and for pilot plant investigation. Grants given by the Council have helped to draw into the scheme of coordinated research the work of large numbers of scientists working at different centres in the country.

4. As scientific work has expanded in recent years, the problems of training scientific manpower in sufficient number and utilising the available personnel to the best advantage of the country have gained in urgency. On the problems of scientific manpower there has been no comprehensive enquiry since the Scientific Manpower Committee submitted its report seven years ago. There-have been many important developments since and, in view of the programmes which are to be undertaken during the second five year plan by the national laboratories, the Atomic Energy Department, the universities and various research associations, a fresh review of the problem of scientific manpower would appear to be called for. There are several aspects to be considered in relation to the tasks ahead, such as the numbers required in different fields, areas, of advanced specialisation for which arrangements for training in India as well as abroad may be needed, determination of fields to which the attention of research personnel should be specially directed in the next five years and other problems relating to the development of scientific manpower.

5. During the first five year plan the Council of Scientific and Industrial Research completed work on the establishment of national laboratories for Physics, Chemistry, Metallurgy, Fuel, Glass and Ceramics, Food Technology. Drugs, Electro-chemistry, Road Research, Leather and Building Research. A Research institute for

Electronics at Pilani is also being set up, and a national botanical garden scheme has been taken up at Lucknow. The national laboratories are engaged in fundamental and applied research with special reference to the problems of industries falling within their spheres. All these laboratories are associated with development work connected with industrial standardisation. Each national laboratory has its own detailed programme of work drawn up by expert committees. Thus, besides doing fundamental work on thermionic emission of electrons, ultrasonics and properties of materials at very low temperatures, the National Physical Laboratory has undertaken studies on industrial standards, investigations on raw material for industries, standardisation of testing procedures and testing and manufacture of radio components. The Fuel Research Institute will continue its work on the detailed survey of the physical and chemical properties of coal found in the country, and, amongst other investigations, will carry out pilot plant work on low temperature carbonisation of different types of coals, blending of non-coking and coking coals and utilisation of lignite. The Glass and Ceramics Institute will continue its work- on improvements in the quality of ceramic products, studies of glass sands and clay in regard to their suitability for the glass and ceramic industry and investigation on processes for the production of porcelain, foam glass, etc. The Institute will also be producing optical glass on a small scale. The Leather Research Institute will study the causes and methods of prevention of deterioration of Indian raw hides and skins, processes for improving the quality of leather and production of new vegetable and synthetic tanning materials. The National Metallurgical Laboratory will continue its work on beneficiation of metallic minerals, the development of new steels, extraction and utilisation of rare metals whose ores occur in India, development of refractories from indigenous sources, etc. The Electro-chemical Research Institute has developed the production of electrolytic manganese from manganese ore on a pilot plant basis. Similar programmes having an intimate bearing on the development of industries are being followed in other national laboratories.

DEVELOPMENT OF ATOMIC ENERGY

6. Production of electric power from nuclear energy and the application of nuclear science in agriculture industry, medicine and health are the main aims in the field of atomic energy. The Atomic Energy Commission was setup in 1948 to lay the foundation for atomic energy development in India and to build up groups of scientists in the different fields of science related to atomic energy. In this task the Commission was assisted by the Tata Institute of Fundamental Research which, since its foundation in 1945, had trained a team of scientists in nuclear physics and the associated experimental techniques. As a result of the activities of the Commission it has now become possible to embark upon large-scale research and industrial projects and the Department of Atomic Energy was set up in 1954 to take charge of development work in this field. In 1955, the work of setting up the Atomic Energy Establishment was started at Trombay. The Establishment consists of three main groups, for physics, chemistry and engineering research. In addition to housing its laboratories and its research and prototype reactors, the Establishment will also have adequate facilities for pilot plant experiments. The scientific staff of the Establishment was about 200 in 1955 and is planned to increase to 800 scientists by 1959. A swimming pool reactor, designed and built at Trombay by the personnel of the Establishment is expected to be in operation.^by the middle of 1956. The reactor will produce fsotopes for biological, medical and industrial research and be used for training engineers for later projects. A high-power, high-flux reactor, received under the Colombo Plan from Canada, is expected to go into operation in 1958; this "Canada-India Reactor" is a powerful instrument for material testing and engineering research connected with advanced power reactors.

7. To ensure the balanced implementation of the Indian atomic energy programme it is proposed that the country should be self-sufficient in the requisite materials and in processing techniques. A brief indication may therefore be given of the activities of the Department in this direction. Among the basic materials required for atomic energy work are uranium, thorium, heavy water, graphite, zirconium and beryl; and extensive geological and geophysical survey and prospecting for the appropriate minerals is in progress, in addition to the Travancore-Cochin deposits ofmonazite, which contain thorium, uranium and zirconium, and the Rajasthan pegamtites holding beryl as well as various radio-active minerals, newly located deposits include those of beryl, and columbite, tantalite and various uranium bearing minerals in Bihar, Udaipur, the Nellore District and other parts of India. The Department's industrial' projects, which are being developed with a view to enabling the country to meet all her needs of these materials as rapidly as possible, include the following:—

(1) The Monazite Processing Plant at Alwaye which began production in 1952 and will double its processing capacity to 3,000 tons of monazite per year during 1956 to 1961; in addition to its residual thorium uranium cake, this plant produces rare earths products and trisodium phosphate,

(2) The Thorium/Uranium Plant at Trombay which began production in 1955, processes the residual thorium uranium cake extracted in the Alwaye plant and produces thorium nitrate and uranium, the fuel value of which is equivalent to some 1,000 million tons of coal annually.

8. Other projects at an advanced stage of planning or investigation, and likely to be in operation by 1961, include:

1. A Pilot Plant for extracting Uranium Ore from the tailings of the Indian Copper Corporation factory and for

beneficiation of other low grade uranium ores. This plant will be at Ghatsila, and have a processing capacity of 200 tons per day,

2. A Uranium Purification Plant at Trombay planned for completion in 1957. This plant will process the impure uranium extracted from monazite into uranium metal of atomic purity for use in a reactor,
3. The Joint Production of Heavy Water and Nitrogenous Fertilizer at one of the new fertilizer factories at Nangal in the Punjab,
4. A Plant for Production of Atomically Pure Graphite associated with the manufacture of graphite electrodes for industry,
5. A Plant for the processing of Beryl Ore into berylium oxide,
6. The setting up of a corporation for consolidating and rationalizing the mineral sands-separation industry on the West Coast,
7. A Pilot Plant for producing Titanium Sponge Metal from rutile and ilmenite sand, and
8. A Plant for the production of Zirconium Metal.

PROGRAAMME OF SCIENTIFIC RESEARCH

9. At the end of 1953 the Government of India set up the National Research Development" Corporation as an organisation devoted to bridging the gap between' research and development and securing maximum practical utilisation by industries of the results of research. The Corporation undertakes trial production of completed processes in co-operation with industry, and licences patents and inventions held by it. So far 177 inventions have been reported for development.

10. Science departments in universities have been assisted during the first five year plan by the Ministry of Education and the University Grants Commission in equipping their laboratories and libraries and in their building programmes and by the Council of Scientific and Industrial Research in specific research programmes - and projects. Valuable work is being done at several university centres in such fields as chemistry, radio and nuclear physics, cosmic rays and in a number of other specialised fields. The importance of building up university research institutions as the main source of supply of competent and trained scientific workers is well recognised. During the second five year plan the University Grants Commission expects to provide a sum of Rs. 17 crores to Universities for the further building up of research facilities and for higher technological education.

11. Research organisations such as the Indian Institute of Science, Bangalore, the Tata Institute of Fundamental Research, Bombay, the Indian Institute of Nuclear Physics, Calcutta, the Bose Research Institute, Calcutta, the Indian Association for the Cultivation of Science, Calcutta, the Birbal Sahni Institute of Paleobotany, Lucknow and the Sri Ram Institute for Industrial Research, Delhi, have important research programmes. The plan provides funds for expanding research facilities at these institutions also.

12. Among associations engaged in disseminating scientific knowledge may be mentioned the Indian Science Congress Association, the National Institute of Science, New Delhi, and the Indian Academy of Sciences, Bangalore. These associations publish academic journals and provide forums for scientific thought and discussion. Similar work is undertaken by associations representing different branches of modern science such as the Indian Physical Society and the Indian Chemical Society. Grants are made to many of these organisations either directly by Government or through the National Institute of Sciences to enable them to develop their activities.

13. For the development programmes of the Council of Scientific and Industrial Research the second five year plan provides for an outlay ofRs. 20 crores, in addition to amounts needed for carrying on the current activities of the Council. The Council has taken over the Central Laboratories for Scientific and Industrial Research, Hyderabad, and the Indian Institute for Medical Research, Calcutta, the latter being renamed as the Indian Institute for Biochemistry and Experimental Medicine. Among new institutions which are to be established are a Mining Research Station at Dhanbad, a Central Mechanical Engineering Institute near Calcutta, a National Biological Laboratory, a Science and Industry Museum at Calcutta and a regional laboratory in Assam. At Sambhar in Rajasthan a salt research station is to be set up with a view to exploitation of the valuable Sambhar salt bitterns. Centres or units are also proposed to be set up for gas turbine research at the Indian Institute of Science, Bangalore, for rain and cloud physics research in New Delhi, for research in essential oils at Poona, Dehra Dun, Kanpur and Bangalore, for wind power development, for investigations into Indian medicinal plants and for bio-physical research. Investigations on the replacement of coking coals by non-coking coals in the smelting of iron ore with a view to conserving coking coal reserves wiH also be undertaken on a pilot plant basis. The Research Committees of the Council have drawn up comprehensive programmes of research to be undertaken in scientific and technological fields, in various branches of engineering and in biological subjects.

14. The'Botanical and Zoological Surveys of India have drawn up their u;velopment programmes for the second year period and work on the preparation of a National Adas is in progress.

15. There are very few specialised research institutes associated with individual industries in India, the principal exceptions in this field being the Ahmedabad Textile Industries Research Association, the Indian Jute Mills Association Research Institute, and the Silk and Art Silk Mills Research Association. The Council of Scientific and Industrial Research have assisted in the formation and functioning of these institutions.

16. A scheme for research fellowships and scholarships in universities and research institutes Was introduced a few years ago on the recommendation of the Scientific Manpower Committee. The Ministry of Education and the Council of Scientific and Industrial Research, grant a large number of research fellowships.

17. Three rural scientific centres known as vigyan mandins have been established and, depending on the experience gained, it is proposed to set up 90 to 100 such centres during the second five year plan. The object of the vigyan mandir scheme is to help and advise villagers on matters vitally concerning their well-being and to educate them on methods of science which would enable them to take greater advantage of programmes in agriculture, health, sanitation, etc. Vigyan mandirs are to be set up in community project areas and will disseminate scientific information of interest to the rural population. Simple literature on agriculture and public health matters will be made available, preserved specimens and models for illustrating plant diseases, insects etc., will he-kept as exhibits and hand-operated spraying and testing equipment for insecticides and fungicides will be demonstrated to villagers. The scheme is being implemented with the help of an advisory committee in which a number of Ministries arc represented.

ADOPTION OF THE METRIC SYSTEM

18. An important decision which has been taken by the Government of India, and has received the approval of Parliament is to standardize weights and measiiies all over the country on the basis of the metric system. At present there is a great diversity in weights and measures used in different parts of the country. Not only do weights and measures differ from one area to another, but even in the same area units used for different commodities also differ, and an expression such as a "ser" represents different weights at different places. Such a diversity in weights and measures used for the common transactions of daily life is a source of confusion and difficulty. Added to this lack of uniformity is the further disadvantage of the complexity of calculations involved in the use of the various 'systems' of weights and measures now prevailing which have grown haphazard and have not always been based on scientific, principles.

19. The adoption of the metric system of weights and measures would bring about standardisation both at the national and international level and simplify calculations of different kinds. A reform of this character is best undertaken in the early stages of industrialisation, when it can be effected with the minimum of cost and the least amount of dislocation, for delay aggravates the difficulties. It has, therefore, been decided to introduce the reform, according to a phased programme, with immediate effect, spreading it over a period of 10 to 12 years, by the end of which it is expected that units of weights and measures based on the metric system will be in universal use in the country.

20. As a first step towards facilitating the adoption of the metric system it was decided to introduce the decimal system of coinage during the second plan period. The necessary legislation has already been enacted and preparations are afoot to bring new coins in circulation as soon as the mints are able to manufacture the requisite number. A Standing Metric Committee has been formed at the Centre under the Chairmanship of the Minister of Industry. The Ministries of the Central Government and some of the departments under them as well as most of the State Governments have set up their own Metric Committees to formulate programmes for changing over to the new system and for giving continuing attention to the problems that may arise from time to time during the period of transition. The Standing Metric Committee has the responsibility of giving advice on the manner and phasing of the change, coordinating the work of various agencies, and watching the progress of the implementation of the reform. A Technical Subcommittee of the Standing Metric Committee has been formed to render advice to Ministries and State Governments for meeting technical difficulties in connection with the immediate programme for the next five years. There is another Sub-Committee on Education and Publicity. The decisions of the Standing Metric Committee are circulated to all the Ministries of the Central Government, the State Governments and organisations in the field of commerce and industry. An important decision that has been taken is that whenever any new plant or machinery is ordered or a new line of production is established, care should be taken to ensure that the equipment ordered as well as the line of production established is based on the metric system so that no transitional difficulties in respect of these arise in the future.

21. A bill for establishing metric standards of weights and measures has been drawn up and is expected to be introduced in Parliament during the current year. While the completion of the reform may take 10 to 12 years, it is to be expected that important advances will have been made in several directions even during the next five years. The iriform is of fundamental importance for scientific and industrial development and should therefore be put through with speed. There should be full publicity about the system and the advantages that it will bring to the people. Popularisation of the metric system among the masses in rural and urban areas should receive high priority and

various media suited for the purpose should be employed. The National Extension Service with its close contact with rural areas can do much to explain the advantages of the metric system to people in the villages and gain their enlightened acceptance of the reform.

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