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Chapter 28:

SCIENTIFIC AND INDUSTRIAL RESEARCH

The vital role of science in modern life is now generally recognised. Apart from the vast changes it has brought about, the development of a scientific temper in the people is considered important. In the planned economy of a country, science must necessarily play a specially important role. Improvements in techniques evolved as a result of scientific research bring about great increases in production in the different sectors of the economy. National resources are augmented by the substitution of cheap and abundant materials for those in scarce supply and by finding uses for materials which have remained unutilised. A balanced programme of research covering every sector of the economy is essential therefore for the development of a country. We have made our recommendations for research in agriculture, forestry, mineral development, etc. in the respective chapters which deal with these subjects. In this chapter we give a short account of the growth of institutions in other spheres of scientific research in recent years, their achievements and their programmes of work.

2. Prior to World War II, very little attention was given to the problem of scientific and industrial research in this country. A number of universities and institutes carried out research, mostly on fundamental aspects of science. Certain industries also had their own research organisations. However, industry depended, by and large, on foreign techniques and did not develop research programmes of its own. It was left to World War II and the emergence of India as a major supply centre for the armed forces in the East to focus attention on the importance of scientific and industrial research. A large number of products which had been imported into the country had to be manufactured to meet both civilian and military needs. Indian substitutes had to be found for imported materials and processes had to be developed which would use these materials in place of imported ones. In these circumstances the Government of India constituted the Board of Scientific and Industrial Research in 1940. The Council of Scientific and Industrial Research was formed in 1942. Much useful work was done under the auspices of these two bodies during the war. A number of problems, mostly related to military needs, were tackled and processes were developed for producing essential articles from indigenous materials. A notable example of work during wartime is the development of processes for the use of vegetable oils in the manufacture of lubricants. This helped in meeting the shortage of petroleum lubricants and also had the advantage of finding suitable uses for Indian oil seeds at a time when the demand for them had been reduced due to the closure of European markets.

3. Since independence there has been a greater emphasis on the provision of additional facilities for the promotion of scientific and industrial research. The most significant development in this sphere has been the establishment of a chain of national laboratories and research institutes in different parts of the country. These institutions are :

1. The National Physical Laboratory, New Delhi.
2. The National Chemical Laboratory, Poona.
3. The National Metallurgical Laboratory, Jamshedpur.
4. The Fuel Research Institute, Jealgora.
5. The Central Food Technological Research Institute, Mysore.
6. The Central Drug Research Institute, Lucknow.
7. The Central Glass and Ceramics Research Institute, Calcutta
8. The Central Road Research Institute, Delhi.
9. The Central Building Research Institute, Roorkee.
10. The Central Leather Research Institute, Madras.
11. The Central Electro-chemical Research Institute, Karaikudi.

In the case of most of these institutions the process of establishment is nearly complete, but in some, like the Central Leather Research and Central Building Research Institutes, only nucleus units have been functioning so far. The Central Electro-chemical Research Institute has not started functioning yet. The Plan provides for the completion of buildings and the installation of the necessary equipment to enable the laboratories to function fully. In addition, the following three research institutes are proposed to be established during the period of the Plan :

1. A Radio and Electronics Research Institute,

2. A Mechanical Engineering Research Institute, with special emphasis on the study of problems of cottage and small-scale industries, and

3. A Central Salt Research Station.

4. The National Physical Laboratory in Delhi and the National Chemical Laboratory at Poona deal with general industrial problems and are responsible for investigations of the 'residuary' type—that is, investigations relating to industries for which no specialised institutions have been established. The remaining laboratories are specialised institutions dealing with problems of specific industries. The main function of all these institutes is to look for new knowledge, fundamental or applied. They will examine existing industrial processes with the object of introducing improved techniques of manufacture and the production of standard materials, wherever possible, at reduced costs. At the same time, they will evolve new processes and new products, preferably from indigenous raw materials, and assist in the starting of new industries in the country.

5. The establishment of national laboratories and research institutes has a special importance in a country like India where medium and small-scale producers contribute a considerable proportion of industrial production. These industries cannot afford to have research facilities of their own, as the larger producers can. The research institutions will bring the fruits of research within their reach and enable them to reduce costs and improve the quality of their products. The establishment of these laboratories and institutes is thus complementary to the objective of promoting the development of small-scale and cottage industries. In addition to these major research institutes, it is desirable to direct particular attention to the improvement of techniques in cottage industries. Such improvement may ultimately produce a far greater result all over the country than a limited number of large-scale industries.

6. Most of the laboratories and institutions have already begun work by undertaking assessment of resources, conducting tests and evolving standards, giving advice to the Government and to industry and developing useful processes. Laboratory investigations on a number of projects have been completed. Amongst these are the manufacture of calcium diphosphate, nicotine from tobacco waste, citric acid, calcium gluconate, vitamin 'C', electrolytic production of beryllium oxides, etc. Work on coal washing and coal blending has led to several useful applications. The possibilities of using Didwana salt-cake in the manufacture of certain types of glass have been established and compositions for the manufacture of railway signal glasses worked out. Investigations on improvements in the quality of salt have been completed and a study of the structure of bamboo has brought out the possibilities of bamboo as a raw material for the production of newsprint.

7. In many cases, however, the laboratories are just emerging from their formative stage. As mentioned above, for some of them only nucleus units have been functioning. But even where the establishment is nearly complete, initial difficulties of finding suitable personnel, getting proper equipment and organising appropriate research programmes remain. As these difficulties are overcome and research programmes progress, the contributions of the laboratories and institutes will progressively increase in volume as well as in significance.

8. In the chapter on 'Mineral Development' we have indicated some lines of research work for the Fuel Research Institute, the National Metallurgical Laboratory and the Central Glass and Ceramics Research Institute. In the chapter on 'Industrial Development and Policy' we have mentioned some important measures for the effective utilisation of the by-products and waste products of certain industries. We have also drawn attention to the need for research into the development of new processes for the utilisation of local resources on a long-term basis. We have laid down certain targets and expansion programmes in the private and public sectors of industry. Laboratory investigations on some of the problems mentioned above have been undertaken by the national laboratories. Utilisation of lime sludge from Sindri, manufacture of dicalcium phosphate, kotka phosphate and nitrophosphate fertilisers, and production of sulphur by microbiological reduction are cases in point. There are other items like production of caustic soda and sulphuric acid from sodium sulphate, sulphur from magnesium sulphate, manufacture of calcium lactate, para-aminosalicylic acid, new paints, varnishes and pigments, etc. in regard to which research can substantially assist. We suggest that the Council of Scientific and Industrial Research should examine these targets in consultation with industry and arrive at a programme of research to assist in their achievement.

9. The national laboratories and research institutes are working in collaboration with the Indian Standards Institution in laying down standards for various raw materials and finished products within their respective fields. We consider this work to be of great importance. Specification of proper standards is essential for improving the quality of products especially of raw materials and semi-manufactured goods in which small-scale production prevails. Such standards, besides benefiting the domestic consumers, are of great value for the export trade. Lack of uniformity and adulterations (which are helped by the absence of standard specifications) are the principal reasons for Indian products being rated low and receiving low prices in foreign markets.

PROGRAMME OF LABORATORIES AND INSTITUTES

10. The National Physical Laboratory—This laboratory conducts research on both the fundamental and applied aspects of physics. Among the investigations which have been undertaken at the laboratory, mention may be made of the development of various types of radio components, carbon products, scientific instruments and glass apparatus and inks. The indelible ink used for marking voters in the recent general elections was developed at the laboratory, which also manufactured the entire quantity needed for election purposes. Investigations have also been undertaken on rare minerals and the use of solar energy. The laboratory is also undertaking a number of projects in fundamental research. A scientific documentation centre has been set up in co-operation with UNESCO to provide facilities for the translation and copying of scientific literature to scientific workers in all parts of the country.

11. The National Chemical Laboratory—This laboratory has carried out a number of investigations on processing of indigenous raw materials, extraction of new substances and finding new uses for materials in industry. Amongst these mention may be made of the following : production of tobacco seed oil and extraction of nicotine from tobacco waste, development of kamla seed oil (to replace tung oil) for the paint and varnish industry and improvements in extraction of seed and castor seed oil ; development of new methods of utilisation of chlorine, and research on the manufacture of phosphatic fertilisers. Fundamental research is being done in all branches of chemistry. The laboratory is devoting special attention to demonstration of products which can be manufactured on a small scale.

12. The National Metallurgical Laboratory—The laboratory has been engaged on a number of investigations on beneficiation of ores. Reports of researches on iron-ore, ilmenite, low grade chrome-ore, pyrites and manganese-ores have been published. Further investigations are in progress on beneficiation of pyrites, chrome-ore, wolfram and other ores found in various parts of the country. The laboratory is also conducting investigations on alloy steels, the production of certain classes of refractories and other subjects of interest to the metallurgical industries.

13. The Fuel Research Institute—This institute has been engaged on a detailed physical and chemical survey of Indian coals. The work includes testing large numbers of samples of coals from various coal fields as well as detailed investigations of particular seams and fields. As an example of the latter may be mentioned the survey of the Bermo-seam from which coal is being supplied to the Bokaro power station. A number of stations have been set up in different coal fields for the purpose of the survey. Research has also been conducted at the institute on the blending and washability of Indian coals. The importance of this work in view of the limited resources of high-grade coal has been stressed in the chapter on minerals. Investigations have also been conducted on the possibilities of manufacture of synthetic petroleum. Work on these subjects will be continued during the period of the Plan. Other subjects which are proposed to be taken up include desulphurisation of Assam coals and detailed work on various aspects of the chemistry of Indian coals.

14. The Central Glass and Ceramics Research Institute—The object of the institute is to assist in the rationalisation and improvement of Indian glass and ceramic industries. The institute has started research on improving the quality of bottles and other glass containers and the development of containers which are not made in India at present. A process has also been developed for the manufacture of railway signal glasses. A survey of raw materials for the glass and ceramic industries is being carried out in co-operation with the Geological Survey of India. These research and survey programmes will be continued during the period of the Plan and work will be initiated on such subjects as beneficiation of raw materials and utilisation of waste materials like mica wastes, evolving substitutes for scarce materials like borax and selenium and manufacture of special types of glass which are not manufactured in the country so far.

15. The Central Drug Research Institute—The institute has started research on Indian drugs with a view to isolating their active materials and developing economic processes for the isolation of these. It has compiled an Indian Pharmaceutical Codex, as a companion volume to the Indian Pharmacopoeial List and is undertaking a systematic survey of the medicinal plant resources of India. The institute will conduct experiments on improvement of medicinal plants so as to increase their active principle content and for their systematic cultivation. As India produces a great variety of herbs and drugs which are used in indigenous systems of medicines and a number of which are also exported in appreciable quantities, work at the institute will make a significant contribution to the improvement of national health, as indigenous herbs and drugs are the principal medicines used by the vast majority of the people of this country.

16. The Central Food Technological Research Institute—A principal objective of the institute is to assist in the solution of the food problem by technological as distinct from biological and agricultural methods. The institute has undertaken a series of investigations on the nutritive value of various Indian foods, possibilities of substitution of cereals by processing and fortification of roots and tubers etc. The institute is also conducting surveys on dietary habits and dietary deficiencies. Technological problems of various food processing industries, utilisation of food and agricultural wastes, and problems relating to the storage of cereals and perishable foods are the other main lines of investigation. Attention is also being devoted to the processing and preservation of fruits and vegetables with particular reference to the preparation of new fruit products.

17. The Central Leather Research Institute—As mentioned above, only a nucleus unit of the institute has been

functioning so far. Investigations are being undertaken on the use of indigenous tanning materials and on the normal salting of kips in order to lay down standards and prevent undue weightage of kips for export. Other main lines of research at the institute will include improvements in production and use of indigenous tanning materials ; development of substitutes for materials like wattle bark which are not produced -in any significant quantity in the country, improvements of tanning processes and development of suitable leathers for specialised needs.

18. The Central Road Research Institute—Here also only a nucleus unit has been functioning so far and due to difficulties of obtaining suitable equipment, it has been possible to undertake only a limited number of investigations. These include research on various types of road materials and soils and studies on improvement of alignment, layout and signalisation of roads. The institute is devoting special attention to the problems of rural roads and rural transport. It is working in close co-operation with the Central Public Works Department, the Central Roads Organisation and the Public Works Departments of State Governments, so that the problems experienced in the field can be studied at the institute and results obtained at the institute can be applied to improving road building techniques.

19. The Central Building Research Institute—Research on building materials (including use of new materials) and on building techniques and practices is the main function of this institute. It will place special emphasis on the study of problems connected with providing low-cost houses for lower and middle income groups and for rural areas. Suitable designs for structures have to be evolved for such houses and the use of cheap and abundantly available materials has to be encouraged in place of comparatively scarce and expensive materials like steel. The institute is still in the formative stage and only a nucleus unit has been functioning so far.

20. The Central Electro-Chemical Research Institute—The main function of the institute is to carry out investigations with a view to increasing the productive capacity and efficiency of electro-chemical industries and fostering new electro-chemical industries and utilising Indian raw materials. The institute is expected to start functioning shortly.

21. Besides these laboratories and research institutes, the Council of Scientific and Industrial Research has made contributions towards the promotion of fundamental and applied research at a number of institutions and universities. Surveys of particular resources from time to time, arrangement of symposia and conferences and advice to industry on specific problems are important items in the programme of scientific and industrial research. Deserving of special mention is the compilation and publication of 'Wealth of India', an encyclopaedic record of Indian raw materials and industrial products.

22. The Atomic Energy Commission (India) is sponsoring research in nuclear science and in subjects relating to the production and development of atomic energy for economic and industrial purposes. These projects are being worked out at the Commission's own laboratories and at other research institutes and university laboratories. One of the main objects of the Commission is to train workers in these fields for both research and its application on a large scale. In this the Commission has met with success and teams of selected workers are under instruction at the Tata Institute of Fundamental Research in various branches of nuclear physics, instrumentation, high vacuum work, design, etc. The Commission has set up a unit for producing radiation meters and other electronic instruments to meet the demand for such equipment for laboratory work and geological surveys.

23. The financing of research has so far been mainly the responsibility of the Central Government. To a great extent this will have to continue, though State Governments, universities, etc., will, no doubt, also further research.. In the chapter on industrial development and policy we have referred to the need for initial investment and interest on the part of industry in fostering industrial research. We hope that as industry becomes more and more research minded, it will begin to support research on a large scale. Already several prominent industrial concerns have made substantial contributions towards the cost of establishing national laboratories. The following industrial-research associations have also been established by the industries concerned at their own cost. Government assisting with substantial contributions and offering special facilities such as allowing contributions for research to be treated as a part of the normal business expenditure of an industrial concern under Section 10 (2) XIII of the Indian Income-tax Act:—

1. The Ahmedabad Textile Industry's Research Association, Ahmedabad.
2. The Silk and Art Silk Mills Research Association, Bombay.
3. The South India Textile Industry's Research Association, Coimbatore.

24. The completion of laboratory investigations is only the first step in the application of a scheme for utilitarian purposes. Before the results are actually translated into commercial production, experimentation on a pilot plant is necessary in many cases with a view to obtaining technical data for assessment of the likely form the ultimate production unit is to take and gauging possible difficulties that are likely to be met with. This step also provides preliminary data on the economic possibilities of the process. In the conditions under which industrial development has taken place in this country, this duty has to devolve upon the laboratories concerned. As the work of the laboratories develops and their activities gather momentum, their need for pilot plants will also expand. In the development programmes for scientific research financial provision has been made for purchase of pilot plant

equipment for most of the laboratories, as required.

25. For scientific research to make its full contribution it is necessary that the results of laboratory work should be utilised in actual practice by being translated into commercial production. The importance of this subject was recognised in the establishment of the industrial Research Utilisation Committee (now Industrial Liaison Committee) in 1941. The results which have attended the efforts of this Committee are encouraging but much still remains to be done. The Council of Scientific and Industrial P

26. Promotion of scientific research on a large scale calls for an adequate supply of trained personnel. For manning the research institutes and also for running industries, a large number of scientists and technicians will be required. In the chapter on Education we have described the steps proposed for meeting the shortage of higher technical and scientific manpower.

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