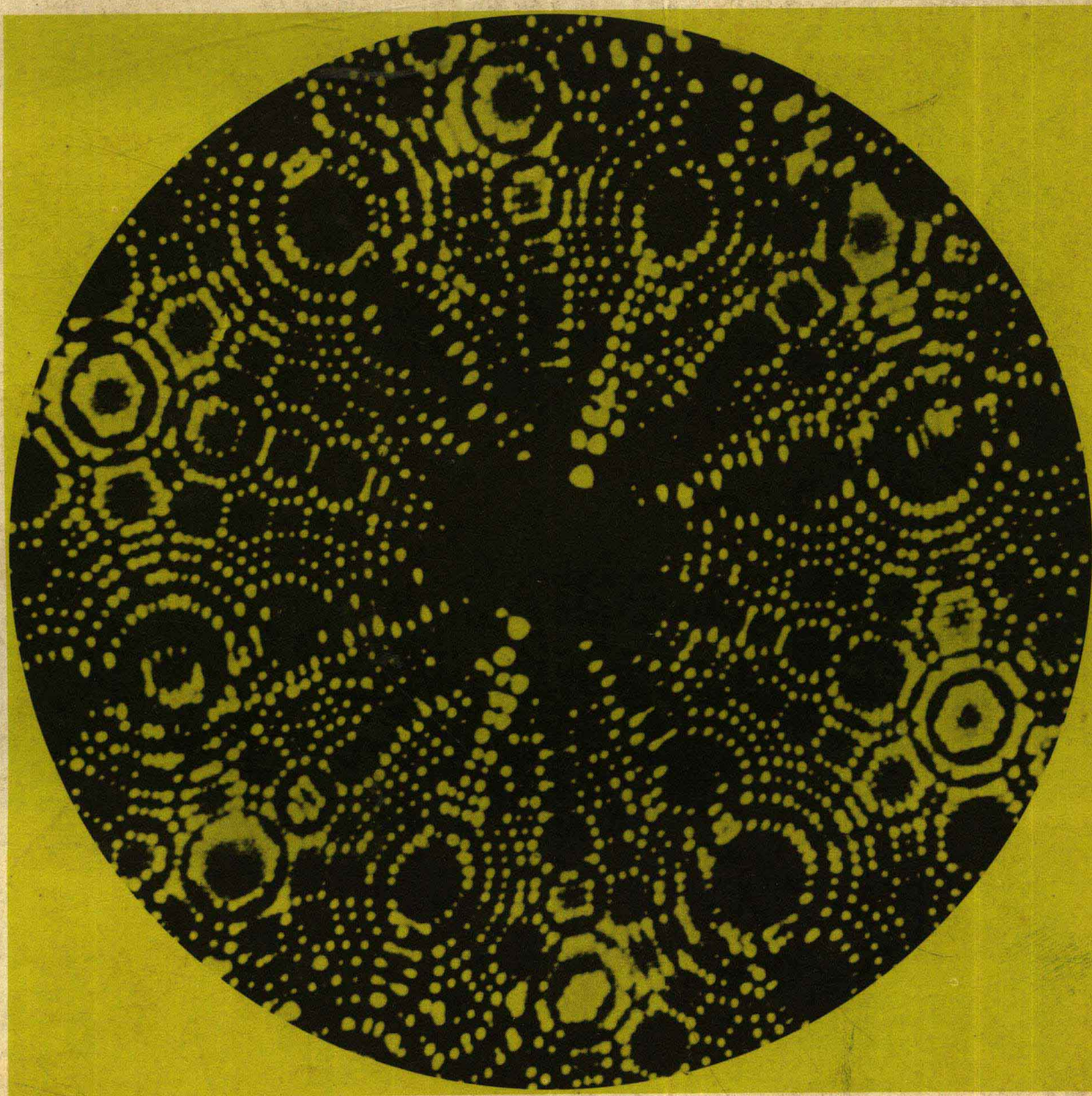


No.27

National science policy and organization of scientific research in India

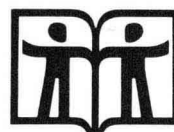
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PREFACE

The Unesco series "Science policy studies and documents" forms part of a programme "to collect, analyse and disseminate information concerning the organization of scientific research in Member States and the policies of Member States in this respect", authorized by resolution 2.1131b, adopted by the General Conference of Unesco at its eleventh session in 1960 and confirmed by similar resolutions at each subsequent session.

This series aims at making available to those responsible for scientific research and development throughout the world factual information concerning the science policies of various Member States of the Organization as well as normative studies of a general character.

The country studies are carried out by the governmental authorities responsible for policy making in the field of science in the Member States concerned.

The selection of the countries in which studies on the national scientific policy are undertaken is made in accordance with the following criteria: the originality of the methods used in the planning and execution of the national science policy, the extent of the practical experience acquired in such fields and the level of economic and social development attained. The geographical coverage of the studies published in the series is also taken into account.

The normative studies cover planning of science policy, organization and administration of scientific and technological research and other questions relating to science policy.

This same series also includes reports of international meetings on science policy convened by Unesco.

As a general rule, the country studies are published in one language only, either English or French, whereas the normative studies and the reports of

meetings are published in both languages.

The present study on the national science policy and the organization of research in India was prepared under a contract with Unesco by the Council of Scientific and Industrial Research of India. Overall supervision of the study was carried out under the responsibility of the Committee on Science and Technology, Cabinet Secretariat, by Dr. B.D. Nag Chaudhuri Chairman, and Dr. V. Ranganathan, Secretary. The study reflects the situation of research as of October 1970, with statistical data relating to 1969 and previous years.

The general plan is as follows:

Part I gives the historical background of scientific development in India.

Part II deals with the organization of scientific and technical research in the Republic and States, both in the public and private sectors, together with institutional structures and operational links.

Part III contains information on financing of scientific and technical research.

Part IV is concerned with human resources in science and technology, their main qualifications and status.

Part V describes the principal aims of national science policy, drawing attention especially, to the scientific policy resolution adopted by the Government in 1958.

Part VI relates to political structure and provides basic socio-economic data.

Annexes give the lists of higher education establishments, scientific and learned institutions, research organization, etc...

Tables, diagrams and figures at the end of the publication illustrate and supplement information given in the different chapters of the study.

Responsibility for the facts presented and opinions expressed rests with the authors.

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NOTE: In this study, the following units are sometimes used:

1 crore :	10,000,000
1 lakh :	100,000

PART I

HISTORICAL BACKGROUND OF SCIENTIFIC DEVELOPMENT

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INTRODUCTION

India's contributions in the field of science during the earlier part of her history are well known. The contributions of Aryabhatta, Susruta, Varahamihira, and Bhaskara are important landmarks in the history of science. However, there was a sudden break in scientific achievements after the twelfth century due to various historical factors; although in certain areas, such as astronomy, the tradition continued and resulted in the setting up of observatories at Jaipur and Delhi.

Science in the modern sense took root in India in the eighteenth century. The establishment of the Asiatic Society of Bengal by Sir William Jones in 1784 was an outcome of the interest created at that time in scientific research. The Society has since then played a prominent part in the development of scientific activities in India.

During the nineteenth century a number of organizations were set up for encouraging scientific work in various disciplines such as zoology, botany, anthropology, mathematics, physics, chemistry, meteorology, geology, medical science, etc. The Trigonometrical Survey (1800), the Geological Survey (1851), the Archaeological Department (1862), the Indian Museum (1866), the Indian Coastal Survey (1875), India Meteorological Department (1875), the Botanical Survey (1890) and the other periodical surveys opened up vast and previously almost untouched fields for investigation. Medical colleges were started in Madras and Calcutta in 1835 and in Bombay in 1845. Scientific work was also carried out by medical men, engineers and civilians working in defence establishments, in their spare time. A number of basic monographs on various scientific subjects were published.

Medical research was placed on an organized basis in 1869 when Dr. Lewis and Dr. Cunningham initiated a systematic research on cholera, malaria, beri-beri and kala-azar. The Haffkine Institute was started in 1899 as the Plague Research Laboratory, and gradually expanded its activities to include antirabic, pharmacological and biochemical research.

Research work in agriculture and veterinary science was mostly done in the various provincial departments of agriculture. Agricultural departments were set up in Bombay (1885), Madras (1889), Shillong (1894), Allahabad and Nagpur (1895), and Bengal (1896). The Imperial Bacteriological Laboratory was established in Poona in 1889 for veterinary research and was moved to Mukteswar in 1893, where it later became the Indian Veterinary Research Institute.

The Indian Association for the Cultivation of Science was the first research centre to be established through private munificence. It was founded in 1876 by Dr. Mahendra Lal Sircar for the propagation of science through public lectures, and later

became an important centre for physical research, culminating in the discovery of the Raman Effect.

Early in the twentieth century the Government of India established a number of important research institutes. The Imperial Agricultural Research Institute (1905) was set up in Pusa, Bihar. The Central Research Institute for Medical Research (1905) in Kasauli, the Forest Research Institute (1906) in Dehra Dun, the King Institute of Preventive Medicine (1903) in Madras, and the Pasteur Institute (1907) in Coonoor were some of the important institutes established for carrying out applied research in various fields. For the prosecution and assistance of research relating to the causes and prevention of diseases, the Government of India in 1911 established the Indian Research Fund Association which later became the Indian Council of Medical Research.

The Indian Science Congress was inaugurated in 1914, with Sir Ashutosh Mookerjee as its first President; the Asiatic Society of Bengal was asked to undertake the management of this new organization. The Congress has played a prominent rôle since then in providing a forum for Indian scientists to meet and discuss every year the results of their research work.

The Zoological Survey of India was set up in Calcutta in 1916.

The Bose Institute was established in Calcutta in 1917 by Sir Jagdish Chandra Bose. It is famous for its pioneering work in biophysical research.

Other applied research institutes established during this period included the Cotton Technological Research Laboratory (1924) in Bombay, the Institute of Plant Industry (1924) in Indore, the Indian Lac Research Institute (1925) in Ranchi, the Toklai Experimental Station in Assam for Research on Tea (1911), and the Dairy Research Institute at Bangalore (1923). As a result of the recommendations of the Linlithgow Commission, * the Imperial Council of Agricultural Research, which later became the Indian Council of Agricultural Research,

* The British Government set up the Royal Commission on Agriculture in India under the Chairmanship of Lord Linlithgow in 1926, to examine the condition of agriculture and rural economy and to make recommendations for the improvement of agriculture and the promotion of the welfare and prosperity of the rural population, including the promotion of: agricultural and veterinary research, experiments, demonstrations and education; compilation of agricultural statistics; introduction of new and better crops; and improvement in agricultural practice, during farming and breeding of stock. The final report was submitted in 1928.

was established in 1929. This was followed by the establishment of further special commodity research institutes.

A number of scientific societies were also established during this decade, including the Institution of Engineers (1920) in Calcutta, the Indian Botanical Society (1921), the Indian Chemical Society (1924) in Calcutta, the Geological, Mining and Metallurgical Society (1924), and the Anthropological Society (1920) in Calcutta.

This activity in scientific research and education was continued at the beginning of the 1930s also. New universities, research institutions and scientific societies came into existence. Scientists began to take greater interest in professional activities. The first Academy of Sciences, then known as the United Provinces Academy of Sciences, was set up at Allahabad in 1930; It later became the National Academy of Sciences. The Indian Academy of Sciences was started at Bangalore in 1934. To

meet the still-felt desire for a central academy of sciences on the pattern of the Royal Society of London, the National Institute of Sciences of India was inaugurated in Calcutta in 1935. In 1945, the Government of India declared the National Institute of Sciences to be the premier scientific society in the country, and the headquarters was shifted to Delhi in 1947. It was renamed as the Indian National Science Academy in 1970.

Indian science began to make an impact on the international scene; the outstanding contributions of S. Ramanujan, P. C. Ray, C. V. Raman, Jagdish Chandra Bose, M. N. Saha, Birbal Sahni, K. S. Krishnan, H. J. Bhabha, S. S. Bhatnagar, P. C. Mahalanobis, Satyen Bose, S. Chandrasekhar, P. Maheshwari, D. N. Wadia, S. K. Mitra, T. R. Seshadri, C. R. Rao, M. G. K. Menon, J. V. Narlikar, H. G. Khurana, brought laurels to the scientists and international recognition to scientific work in India.

UNIVERSITIES AND HIGHER EDUCATION

Ancient India had well-known universities such as Nalanda and Vallabhi, which attracted famous scholars from all over the country. As a result of various historical developments, the traditions established by these universities did not survive. Modern universities were established in 1857 at Bombay, Calcutta and Madras, as institutions patterned on London University. They started purely as examining bodies and continued to be so until the beginning of the twentieth century. They were followed by two more universities, one at Lahore in 1882 and the other at Allahabad in 1887.

In 1902, the Indian Universities Commission was appointed and the Indian Universities Act was passed in 1904. The Government of India Resolution on Educational Policy (1913) recommended a separate university for each of the leading provinces and the creation of teaching and residential universities within each province. Six new universities were established between 1913 and 1921 - Banaras and Mysore (1916), Patna (1917), Osmania (1918), Aligarh (1920) and Lucknow (1921). Lucknow University was established as a teaching, unitary and largely residential university.

After 1921, education was transferred from British to Indian control. Nine more universities were established between 1921 and 1947 with provision for teaching and research, following the recommendations of the Sadler Commission Report on Calcutta University published in 1919. They were mostly of a unitary type. The older universities introduced teaching and research by establishing chairs in physics, chemistry, botany and zoology. Some of the universities, including Calcutta, Banaras, Bombay, also established chairs in applied sciences.

The entire field of university education was reviewed soon after Independence (1947) by an Education Commission headed by Dr. S. Radhakrishnan; its recommendations, which have since been implemented, had considerable impact on the growth of the universities. A later Education Commission, appointed by the Government of India in 1964 under the chairmanship of Dr. D. S. Kothari, submitted its report on 29 June 1966 which has provided the basis for widespread discussion at all levels, regarding the educational reconstruction of the country.

The establishment of a University Grants Commission in 1953, on the lines of the United Kingdom University Grants Committee, had considerable effect on the expansion of facilities for teaching and research in universities through its research projects, fellowship programmes, proposals for advanced centres for research and grants for equipment. The Commission is generally responsible for the co-ordination and maintenance of standards in higher education. It meets the entire expenditure of the central universities, such as the Aligarh Muslim University, Banaras Hindu University, Delhi University, Nehru University and the Visva Bharati University. It also provides financial support to universities and colleges for development programmes and improving the quality and standards of teaching, examinations and research. Grants are paid not only to statutory universities but also to institutions deemed to be universities under Section 3 of the University Grants Commission Act, 1956, for maintenance and development. The total number of universities is now 83 and the number of institutions deemed to be universities is 10 (see Annex I).

The Commission has started a number of "Centres of Advanced Study" in Indian universities, in special fields of astronomy, botany, chemistry, geology, mathematics, physics, zoology, etc. At present there are seventeen Centres of Advanced Study in Science (see Annex I). These centres which are intended to encourage the "pursuit of excellence" and to raise standards at the post-graduate and research levels, function on an all-India basis and provide conditions and facilities attractive to scientists of outstanding ability and qualifications. Summer schools and seminars are held, periodically, at these centres to enable teachers and research workers to acquaint themselves with the latest developments in their respective fields of work.

Technical education

The All-India Council for Technical Education was established by the Government of India in 1946 to advise on all aspects relating to the improvement and co-ordinated development of technical education. The Scientific Manpower Committee was constituted in 1947 to assess the requirements for various categories of scientific and technical personnel and to recommend appropriate measures.

The All-India Council, after carrying out a comprehensive survey of technical institutions in the country, formulated a scheme for their immediate improvement and development, to be financed by the Central Government. It also set up Boards of Technical Studies in various fields to prepare courses for various levels of training which could serve as a guide for the institutions and facilitate reorganization of technical education in the country. Four regional committees were set up to survey the needs on a regional basis, to formulate and implement development programmes in a co-ordinated manner and to help in the establishment of liaison between industry and technical institutions. A certain awareness of the importance of technical education to national development had already been established by the time India attained independence in 1947.

Institutes of technology

An important step taken by the Central Government to develop facilities within the country for advanced technological training and research was to establish five higher technological institutions. The concept behind the institutions is to make provision for training the highest possible grades of technologists in a fairly large number. The Indian Institute of Technology, Kharagpur, the first of the five, started functioning in 1951. The Indian Institutes of Technology at Bombay, Madras, and Khanpur admitted their first batches of students in 1958, 1959 and 1960 respectively. The College of Engineering and

Technology established in Delhi in 1959 was raised to the status of an Indian Institute of Technology in 1961.

Regional engineering colleges

There are 14 regional engineering colleges set up with UNDP assistance. Seven of these colleges have introduced industrially oriented post-graduate courses in selected branches of engineering and technology in co-operation with industry.

National Council of Education Research and Training

The National Council of Educational Research and Training, established in 1961, was entrusted with the tasks of: (i) undertaking, aiding and promoting research in all branches of education; (ii) organizing advanced pre-service and in-service training and disseminating improved techniques and practices; (iii) organizing extension services for institutions engaged in educational research and training of teachers; and (iv) developing and improving multipurpose secondary education. The Council has ten departments covering basic education, adult education, science education, audio-visual education, teacher education, curriculum evaluation, psychological foundations, educational administration, foundations of education, field services, and a central science workshop.

The Governing Body of the Council is assisted by the Board of Educational Studies, the Central Committee on Educational Literature and Committees on Appointments, Finance and Works. Functioning through three standing sub-committees, the Board examines all proposals relating to research, training and extension projects referred to it and initiates, guides and co-ordinates research and training activities of the Council. The Committee on Educational Literature supervises the Council's programme of producing textbooks and other educational literature.

The Research and Teachers' Training Programmes of the Council are developed through the National Institute of Education at New Delhi and four regional colleges of education at Ajmer, Bhubaneswar, Bhopal and Mysore. The Institute's programme is, at present, being implemented by its constituent parts - the National Institute of Audio-Visual Education, the National Institute of Basic Education, the Directorate of Extension Programmes for Secondary Education, the Central Institute of Education, the National Fundamental Education Centre, the Central Bureau of Educational and Vocational Guidance, the Department of Science Education and the Central Bureau of Textbook Research.

At the beginning of the twentieth century, some attempts were made to co-ordinate the research activities of the various departments of the Government of India. As a result, the Board of Scientific Advice was set up in 1902. The Board met periodically to discuss problems of common interest; its annual reports gave valuable information on the progress of scientific research in India carried out by various scientific departments, and were communicated to the Royal Society of London, which acted as adviser to the Board and the Government of India and made valuable suggestions from time to time. The Board ceased functioning in 1924.

With the start of World War I, the Government of India became acutely aware of the need for building up scientific research in India, especially applied research, in a systematic manner. The Indian Industrial Commission, set up by the Government in 1916 under the chairmanship of Dr. Holland, was a result of the isolation of India during the war. Prominent leaders such as Pandit Madan Mohan Malaviya and J. N. Tata were members of this Commission. Its report covered exhaustively the state of research, nature of education and extent of industrialization in India up to 1918. Its recommendations were of a far-reaching character. It stressed the need for building up Indian industries based on local raw materials. It recommended the setting up of laboratories for testing industrial products, because of the inadequate testing facilities for Indian products at the Imperial Institute, London. The Commission stressed the need for an All-India Chemical Service to advise and assist provincial governments in launching an extensive programme of industrialization. The Chemical Services Committee, set up to examine this proposal, endorsed this recommendation, but the idea was abandoned after the First World War.

Co-ordination of industrial research

The need to co-ordinate industrial research activity was considered from time to time. The views of the provincial governments on this important question were sought in 1928. There was a consensus as regards the desirability of co-ordinating industrial research in India and the need to set up a council for industrial research, but on account of the prevalent financial stringency no action was taken to implement these suggestions. However, as a result of the discussions at the Fifth and Sixth Industries Conferences, it was decided to bring into being the Central Industrial Intelligence and Research Bureau to act as a central clearing-house for industrial intelligence, to keep abreast of industrial development both in India and in other countries and to be in a position to give information and advice to industrialists and persons seeking

industrial openings. This was established in 1934 and later became known as the Industrial Research Bureau.

At the outbreak of the Second World War in 1939, the need for a strong and well-staffed industrial research institute was again felt. Supplies of many vital commodities for the war effort were either completely stopped or considerably curtailed. It was soon realized that India, to be an effective source of war supplies, should become industrially self-sufficient. The establishment of a Central Research Organization, therefore, became essential. In 1940 it was decided to create the Board of Scientific and Industrial Research, and soon afterwards the Bureau was merged with the Board. The activities of the latter were supplemented by the Industrial Research Utilization Committee, set up by the Government of India in 1941, to advise on the ways and means for the commercial development of the processes evolved under the auspices of the Board. During the same year the Industrial Research Fund was constituted by the Government of India for the purpose of fostering industrial development in the country, and this was followed by the establishment of the Council of Scientific and Industrial Research as an autonomous body, in 1942. Since then the Council has played a prominent rôle in fostering scientific and industrial research in India.

The Hill report

Professor A. V. Hill, then Secretary of the Royal Society of London, was invited by the Government of India to visit the country, in 1943, and discuss the organization of scientific and industrial research as a part of India's post-war reconstruction plan. After a careful study, he submitted a valuable report embodying a forceful plea for the expansion and better co-ordination of research in India backed by liberal financial support from the Government. Two of the most important recommendations called for the establishment of liaison between India and other countries, and the creation of a central organization for scientific research. It was noted that so long as research organizations of the Central Government remained dispersed under a number of separate departments or bodies, most of them having many other duties and preoccupations, it was not possible to evolve a common plan to guide them all in the best interest of the country. It was therefore, proposed that all the scientific work affecting the welfare of the country, namely, in medicine and public health, agriculture and animal husbandry, industry, surveys and industrial resources, engineering and various services, should be brought under a single central organization, which would function under the

Member (Minister) for Planning and Development.

The Report also proposed the appointment of a Consultative Committee to advise the Member for Planning and Development on general policy in relation to research and on any special matters submitted to it. On the basis of these recommendations, the Government of India set up a Scientific Consultative Committee for Planning and Co-ordination of Research administered by the various departments.

Industrial Research Planning Committee

Another important step taken, immediately after Professor Hill's visit, was the setting up of the Industrial Research Planning Committee, early in 1944, by the Council of Scientific and Industrial Research. This Committee was appointed under the Chairmanship of Sir R. K. Shanmukham Chetty to make a comprehensive survey of the existing facilities for scientific and industrial research in India, including the Indian States, universities, research institutions and laboratories attached to industrial and other concerns, and to report on the means necessary for the co-ordination, control, direction and development of such research by these various agencies, and other steps necessary for the planning of such research. As a result of this survey, the Committee brought out a comprehensive report embodying specific proposals, in the form of a five-year plan, for the development of scientific and industrial research in India. The Committee also recommended the establishment, by the Government of India, of a central research organization to be called the National Research Council, and similar scientific organizations for the promotion of scientific and industrial research in the provinces as well as in the major States.

The Industrial Research Planning Committee considered detailed proposals for setting up a National Chemical Laboratory, a National Physical Laboratory, an Institute of Food Technology, a Metallurgical Institute, a Glass and Ceramics Institute, a Fuel Research Institute, a Road Research Institute, a Leather and Tanning Institute, an Industrial Fermentation Institute and an Electro-chemical Institute. It also considered providing grants-in-aid to universities for strengthening and developing their scientific departments, and the award of scholarships tenable in India and abroad for training research personnel for staffing the various national laboratories. The Committee also recommended the creation of a National Trust for Patents and the formulation of a Board of Standards for drawing up Indian standard specifications.

The reports of Professor Hill and the Industrial Research Planning Committee were considered by the Scientific Consultative Committee. It was decided to prepare a scheme for the central organization of scientific research on the basis of the proposals contained in both these reports and some

other suggestions placed before the Consultative Committee, for submission to the government. Regarding the establishment of some additional specialized research institutes, as recommended by the Industrial Research Planning Committee, the Consultative Committee decided that these might wait until after the establishment of the five laboratories already sanctioned, namely, the National Physical Laboratory, the National Chemical Laboratory, the National Metallurgical Laboratory, the Central Fuel Research Institute, and the Central Glass and Ceramics Research Institute. It was, however, recognized that an Institute of Food Technology was also essential.

The Scientific Consultative Committee endorsed the proposal by the Industrial Research Planning Committee for a cess on industry, supplemented by an equivalent contribution from Government, as essentially a sound method of financing research, and proposed that the method of collection of the cess should be by a surcharge on income tax paid by industrial undertakings; grants-in-aid to universities; the establishment of a National Trust for Patents; and the inauguration of the Board of Standards and Specifications.

Electronics Commission

The Government of India set up in March 1971 an Electronics Commission under the chairmanship of Professor M. G. K. Menon, Director, Tata Institute of Fundamental Research.

The scope of the Commission will be to chart out a strategy for the speedy development of the electronics industry, which is expected to produce goods worth Rs. 2,000 crores per year by the end of the decade.

The major functions of the Commission will be to co-ordinate and aid electronics research in the country, to advise the government on the import of technology and to guide the industry.

On the research front the Commission will co-ordinate the efforts of national laboratories, R&D units in the industry and electronics laboratories in the universities and IITs. It may call for periodic reports from all such units engaged in research to identify technological gaps and overlapping projects and suggest corrective measures.

The Commission will provide financial assistance to specific projects, particularly those falling within the priority areas. The industrial R&D units will be asked to undertake projects aimed at the development of new production processes, cost reduction and import substitution.

The Commission proposes to establish a cell of experts to monitor technological developments in the field the world over. It may seek advice from outstanding Indian scientists working outside the country and set up a pool of electronics scientists and technologists with the view to attract Indians working in the field in advanced countries and find suitable placements for them.