

COUNCIL OF SCIENTIFIC AND
INDUSTRIAL RESEARCH
(INDIA)

A REVIEW

by

Director, Scientific & Industrial Research



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INTRODUCTION

The formation of the Council of Scientific and Industrial Research in 1942 was the natural outcome of events preceding and consequent upon the declaration of World War II.

Prior to World War I (1914-18) and even several years thereafter, industrial research in India had not attracted the attention it deserved. The Imperial Council of Agricultural Research, and the Indian Research Fund Association were functioning to foster the growth of knowledge regarding agricultural and medical problems. The Indian Industrial Commission had in 1919 suggested the establishment of a Chemical Services Committee which had in its turn proposed the creation of an All-India Chemical Service to whom were to be assigned the duties of assisting in the co-ordination of industrial work in progress in the provinces. The formation of an All-India Chemical Service was, however, abandoned due to several causes but the need for co-ordination of industrial research in India was not lost sight of. On several occasions the question was brought up for discussion and in 1928, the provincial governments were asked to give their views regarding the establishment of central agencies and institutions for industrial research. There was general agreement amongst the local governments about the desirability of co-ordinating industrial research in India and one of them suggested the formation of an Imperial Council of Industrial Research on the lines of the Imperial Council of Agricultural Research. At this stage financial stringency stepped in and the subject of co-ordination of industrial research was not pursued till July 1933 when the Fifth Industries Conference met. As a result of the discussion at the fifth and the sixth Industries conference it was decided to bring into being the Central Industrial Intelligence and Research Bureau to act as a central clearing house of industrial intelligence, to keep abreast of industrial developments both in India and other countries and to be in a position to give information and advice to industrialists and persons seeking industrial openings. The Industrial Research Bureau, as it was subsequently named, was thus established in 1934 and the Government of India also recognised the necessity of giving *ad hoc* grants to scientific institutions as occasion demanded and the

need for establishment, with government support, of a central industrial research institute.

The need for a strong and well staffed central industrial research institute was brought to the forefront by the outbreak of the World War II in September 1939. Many sources of supply of finished products were either entirely stopped or much curtailed and it was soon realised that if India was to be industrially self sufficient and an effective source of war supplies, the establishment of a Central Research Organisation was essential. It was therefore decided to keep in abeyance the Industrial Research Bureau and to create the Board of Scientific and Industrial Research which came into existence in 1940.

In the words of the resolution creating the Board, its functions were to be "to advise the government as to the lines on which such research should be conducted and the channels into which it should be guided in order best to serve the object of ensuring the co-ordinated development of Indian industries, particularly of those the importance and possibilities of which have been prominently brought into the forefront as a result of the conditions created by the war". The resolution directed that "the Board will utilise and co-ordinate the work of the existing organizations already employed in this field. It will survey the work that is being done by them, invite proposals from all sources, initiate discussion and make recommendations to the Government of India, who will prescribe from time to time the general lines on which industrial research should be undertaken and pursued. The Board will also report to the Government of India what specific problems should in its opinion be assigned for investigation to the staff directly under the Board on the one hand and to the various scientific and research institutions in the country including University laboratories on the other.

The activities of the Board of Scientific and Industrial Research were supplemented by another body known as the Industrial Research Utilisation Committee set up by Government in 1941 to advise on ways and means for the commercial development of the processes evolved under the auspices of the Board.

On the 14th November 1941, the Hon'ble Dewan Bahadur Sir A. Ramaswamy Mudaliar moved the following resolution in the Legislative Assembly:—

"This Assembly recommends to the Governor-General in Council that a fund called the Industrial Research Fund be constituted

for the purposes of fostering Industrial Development in this country and that provision be made in the Budget for an annual grant of Rs. 10 lakhs to the Fund for a period of five years."

This resolution was passed by the Legislative Assembly and accepted by the Government of India and it was decided to set up a Council of Scientific and Industrial Research as an autonomous body registered under the Registration of Societies Act (Act XXI of 1860) whose functions would be :—

- (a) To implement and give effect to the resolution creating the Industrial Research Fund mentioned above.
- (b) The promotion, guidance and co-ordination of Scientific and Industrial Research in India including the institution and the financing of specific researches.
- (c) The establishment or development and assistance to special institutions or departments of existing institutions for scientific studies of problems affecting particular industries and trades.
- (d) The establishment and award of research studentships and fellowships.
- (e) The utilisation of the result of the researches conducted under the auspices of the Council towards the development of industries in the country and the payment of a share of royalties arising out of the development of the results of researches to those who are considered as having contributed towards the pursuing of such researches.
- (f) The establishment, maintenance and management of laboratories, workshops, institutes and organisations to further scientific and industrial research and to utilise and exploit for purposes of experiment any discovery or invention likely to be of use to Indian industries.
- (g) The collection and dissemination of information in regard not only to research but to industrial matters generally.
- (h) Publication of scientific papers and a journal of industrial research and development; and
- (i) Any other activities to promote generally the objects of the resolution.

The functions of the Board of Scientific and Industrial Research and the Industrial Research Utilisation Committee remained practically unaffected, the only difference being that instead of the government, these bodies were now to tender their advice to the Governing Body of the Council.

The advent of the National Government in India in August 1946 has resulted in the elicitation of a greater interest in the working of the Council of Scientific and Industrial Research, following as it did the realisation of the need for stepping up of scientific and industrial research to promote the welfare of the people of the country.

The Union of India was inaugurated on the 15th August 1947 and although the Cabinet has been fully occupied in considering other problems of national importance, the activities of the Council have not been forgotten or relegated to the background. The need for bettering the fate of the common man by promoting industry and of helping industry to solve its problems through the stimulus of scientific research has been keenly appreciated. The importance attached to these activities is manifest from the fact that 'Scientific Research' forms one of the portfolios assigned to the Prime Minister, The Hon'ble Pandit Jawahar Lal Nehru, who is now the President of the Council with the Hon'ble Dr. Shyama Prashad Mukherjee the Minister for Industry and Supply as the Vice-President. For administrative purposes the Council still remains attached to the Ministry of Industry and Supply.

PRESENT ORGANISATION

The Council of Scientific and Industrial Research is a registered body incorporated under the Registration of Societies Act of 1860 (Act XXI). Its resources are mainly derived from government grants but are occasionally augmented by private benefactions for general or specific purposes. For administrative purposes the Council is at present attached to the Ministry of Industry and Supply. The aims and objects of the Council are to further the purposes described in the government resolution sanctioning its creation and have been fully described in the introduction.

Advisory Bodies

The activities of the Council are guided by the two standing advisory bodies viz. the Board of Scientific and Industrial Research and the Industrial Liaison Committee (replacing the Industrial Research Utilisation Committee) of which the former, primarily concerned with research, occupies an important position in the Council's organisation.

Board of Scientific and Industrial Research

The deliberations of the Board of Scientific and Industrial Research which consists of 23 members (Appendix I) are presided over by the Hon'ble Prime Minister in his capacity as President of the Council of Scientific and Industrial Research. The Hon'ble Minister for Industry and Supply is the *ex-officio* Vice-President. Of these members 9 are scientists, mostly non-officials who hold esteemed positions in their respective spheres and are connected with different Indian research institutions. Six represent important government departments interested in industrial research including the Ministry of Defence and Ministry of Industry and Supply. The remaining six are leading industrialists.

The Board functions as an Advisory Body to the Council on (1) proposals for instituting specific researches (2) proposals for scientific institutions including universities and other departments of such institutions in the scientific study of problems affecting particular trades and industries, (3) proposals for the establishment of research institutes, studentships, scholarships and (4) proposals for specific studies and surveys of indigenous resources as an essential preliminary to systematic investigations in particularly important fields of research.

Board of Research in Atomic Energy

A committee for research in atomic energy was appointed in January 1946 but in view of the important and vast field covered by atomic energy research, it was felt that the problems connected with this intricate subject should not be handled by a small committee of the Board of Scientific and Industrial Research. The Government of India and the Council of Scientific and Industrial Research decided in June 1947 to set up a Board of Research in Atomic Energy to work directly under it. At the same time a Joint Committee with the representatives of the Travancore Darbar for research and development of atomic energy from Travancore minerals was also set up.

Industrial Liaison Committee

The Industrial Research Utilisation Committee was composed of 16 members, mostly industrialists and was presided over by the Hon'ble Minister for Industry and Supply. It functioned as an advisory body to the Council to advise on (1) the selection of the particular concern or concerns to which the results of research schemes should be made available for utilisation, (2) the terms and conditions including the question of payment of royalties etc. (3) the question of the division of the royalties on patent rights, which will vest in the Central Government as between the Central Government on one hand and on the other hand, provincial Governments, institutions and scientists responsible for the research and as amongst scientists themselves; and (4) generally the best method whereby the industrial development of the research can be undertaken and an equitable arrangement made for securing that the services of the scientists concerned are adequately rewarded. The Central Government will be the final authority to decide how the results placed before the Committee will be utilised and by whom and on all other matters on which the advice of the Committee is sought.

The Industrial Research Utilisation Committee continued to function as such till 1943 when it was found that it was growing more and more difficult for the Committee, which had a fairly large personnel, representative of different parts of India and could therefore meet only at long intervals, to cope with desirable expedition with the completed processes, the number of which had been steadily increasing. The Council, therefore, set up at this stage a small Standing Committee of the Industrial Research

Utilisation Committee including two non-official members for dealing with industrial utilisation of the processes evolved under the auspices of the Council.

With a view to ensure early utilisation action on completed researches, it has quite recently been decided to replace the Industrial Research Utilisation Committee by a more compact body which has been styled the Industrial Liaison Committee. This Committee is presided over by the Hon'ble Minister for Industry and Supply as *ex-officio* Vice-President of the Council of Scientific and Industrial Research and includes amongst its members the Director, Scientific and Industrial Research, the Director-General, Industry and Supply, the Financial Advisor to the Council of Scientific and Industrial Research and two Industrialists Sir Shri Ram and Mr. Satya Narain Sinha.

Research Committees

In discharging its functions the Board of Scientific and Industrial Research is assisted by a number of Research Committees of experts, through whom indeed, along with the Director of Scientific and Industrial Research, who is the Technical Advisor and Principal Administrative Officer of the Council the technical work of the Council is largely carried out. As a rule, all important research schemes submitted to the Council for sanction of grants are referred to the Research Committees, according to their respective scope, for a detailed examination and for making recommendations thereon. Each Research Committee as a whole watches the progress of schemes falling within its scope and formulates co-ordinated proposals for further schemes in their respective subject. The Research Committees are also entrusted with the task of formulating programmes of research of a long range character in their particular lines. In the past, however, the pre-occupations of the Council were connected mainly with urgent research problems for meeting war-time needs, and only recently the Research Committees have had the opportunity of taking this planning work with necessary care and earnestness.

There are now 24 Research Committees of the Council as follows :—

1. Glass and Refractories Committee.
2. Electro-Chemical Industries Committee (amalgamating the Graphite and Carbon Electrode Committee).
3. Industrial Fermentation & Biological Products Committee.
4. Dye-stuffs Committee.
5. Fuel Research Committee.

6. Vegetable Oils Committee.
7. Cellulose Research Committee.
8. Heavy-Chemicals and Chemical Industries Committee (including Fertilisers, Naturally Occurring Salts and Sulphur Committees).
9. Pharmaceuticals and Drugs Committee.
10. Plastics Committee.
11. Atmospheric Research Committee.
12. Essential Oils Committee.
13. Metals Committee.
14. Internal Combustion Engines Research Committee.
15. Distillation and other Chemical Plants Committee.
16. Applied Physics Committee, (including the Scientific Instruments Committee).
17. Radio Research Committee.
18. Statistics, Standards and Quality Control Committee.
19. Leather Research Committee.
20. Building Research Committee.
21. Fuel Research Committee.
22. Committee on the Measurement of Geological Time.
23. Beryllium Research Committee.
24. Vanaspati Research Advisory Committee.

Each of these research committees has been constituted on the principle of securing the co-operation of prominent scientists in the country, whether serving in government departments or universities and research institutes or private industry and also of industrialists capable of helping such committees in their work.

Laboratories of the Council

The organisation of the Council comprises some laboratories of its own which have been handed down to it and are now financed from the annual grants to the Council. Shortly before the inauguration of the Council in April 1942, the laboratories set up at the Research Branch of the Government Test House, at Calcutta for the Industrial Research Bureau and later placed under the control of the Director of the Scientific and Industrial Research who has built them up in their present form were transferred to Delhi (as Calcutta was then exposed to the danger of air raids)

and temporarily accommodated in the premises of the Delhi University by special arrangement. When the Council was brought into existence as a corporate body, these laboratories were passed on to it.

These laboratories are divided into two sections—Physical and Chemical—each placed under an Acting Director by a recent decision of the Council for the purpose of giving necessary relief to Director, Scientific and Industrial Research who has some supervising control. The initial equipment of these laboratories, originally planned for the Industrial Research Bureau as an experimental measure was bound to be very limited, and no substantial expansion thereof could be effected during the war years, particularly since the Council took them over. Despite this serious handicap, these laboratories, as will appear from the details set forth in the section relating to the activities of the Council, have rendered a fairly good account of themselves, particularly in view of the strain imposed on them for handling numerous problems of war importance during the last few years.

Journal of Scientific and Industrial Research and Dictionary of Economic Products and Industrial Resources of India.

Comprised in the organisation of the Council are two self-contained units,—one relating to the publication of a monthly journal under the name “Journal of Scientific and Industrial Research,” and the other relating to the compilation of a “Dictionary of Economic Products and Industrial Resources of India.” The latter work has been undertaken with a view to bringing the information contained in the famous “Dictionary of Economic Products” (1907-1908) by Sir George Watt up to date and also to supplement the same with information about semi-processed materials. The publication of such a dictionary is considered essential as much for guiding research in fruitful channels as for rendering an information service in universal demand, since considerable strides have been made in the industrial development of the country and also in the exploration of its resources since Watt’s pioneer work in the line. The Council has set up two Advisory Boards for the Journal and the Dictionary respectively and Editorial Committee for the latter to supervise the compilation work (vide appendix).

ADMINISTRATION

The administration of the Council is vested in a Governing Body of which, as already stated the Hon'ble Prime Minister, as Minister incharge of Scientific Research is the President and the Hon'ble Minister for Industry and Supply, to which ministry the Council is attached for administrative purposes, is the Vice-President. The Governing Body takes decisions on matters of policy, passes the budget of the Council, sanctions grants for various research schemes (with or without modifications) on the recommendation of the Board of Scientific and Industrial Research and also other activities falling within the scope of the activities of the Council. According to its constitution, the budget of the Council is subject to sanction by the Government of the Indian Union.

The Governing Body is composed of 22 members including the Chairman. The President is vested with wide powers in matters of finance within sanctioned budget allotments either by the constitution of the Council or by delegation by the Governing Body which includes members from distant parts of India and cannot meet more than three times in a year. Like the Board of Scientific and Industrial Research, the Governing Body is also composed of eminent scientists, industrialists and representatives of some ministries of the Government of the Indian Union. The fact that some scientist and industrialist members of the Governing Body are also members of the Board, has been particularly helpful in facilitating consideration of technical matters by the Governing Body in their proper perspective. Special mention may be made of the inclusion in the Governing Body of a representative of the Ministry of Finance who advises the Council on financial matters.

The principal administrative officer of the Council is the Director, Scientific and Industrial Research, who is responsible for the administration of the affairs of the Council and exercises supervisory control over its technical and research activities which include not only the Council's laboratories at Delhi but also the various research schemes supported largely by the system of grants-in-aid to universities and research institutes. As Technical Adviser of the Council, he is a member of the Governing Body and also of the two important advisory bodies of the Council, viz. the Board of Scientific and Industrial Research and the Industrial Liaison Committee. He is also the Chairman of some of the Research Committees and is an *ex-officio* member of the rest of them.

On the side of administration the Director is assisted by the Council

secretariat which consists of the Secretary, Joint Secretary, Deputy Secretary, and four Assistant Secretaries with the office staff. The secretariat is mainly concerned with matters relating to finance and budget, establishment, and matters relating to the activities of the Board and the Research Committees, the leasing out of processes evolved under the auspices of the Council in respect of which the patent rights vest in the Government of India on behalf of the Council. The Council secretariat has accordingly organised a patent section of its own which is placed in charge of a qualified expert who assists the scientists in drawing up specifications in the proper manner for obtaining patents in and outside India. The financial duties involve not only the preparation of the budget of the Council and disbursements on establishment but also a lot of accounts work, as under the grants-in-aid system detailed accounts have to be maintained of expenditure on assisted researches in the various universities and research institutes under specific headings like equipment, staff and contingencies. Considerable work is also involved in the utilisation branch of the Council secretariat on account of the procedural formalities to be observed for leasing out processes, in respect of which some important details are furnished under the relevant section hereafter.

On the technical side, the Director's duties and responsibilities relate to the general supervision of work at the Council's laboratories at Delhi, the co-ordination of the work of Research Committees, the compilation of the Dictionary of Economic Products and Industrial Resources of India (for which a separate office has been started within easy reach of the Library of the Imperial Agricultural Research Institute), Industrial and Technical Intelligence, the publication of the Journal of the Council and the planning of new laboratories, of which the last is the most important at the present stage on account of some major schemes awaiting implementation by the Council in the course of the next few years.

The present laboratories of the Council in Delhi are as already stated, divided into two sections, Physical and Chemical. The Physical section is in charge of Sir K. S. Krishnan, F.R.S. who has been appointed Director of the National Physical Laboratory, Delhi. Dr. S. Siddiqui, acting Director, who has been selected as Director of the National Chemical Laboratory, Poona, is in charge of the chemical section. They are assisted by necessary staff of Assistant Directors, Research Officers and Research Assistants.

The Dictionary office is in charge of the Editor-in-Chief who is assisted in his work by some Assistant Editors for such subjects as Botany, Physics, Zoology etc. and a number of technical assistants.

In regard to intelligence the Director is assisted by the Assistant Secretary, (Tech.) of the Council and two technical assistants.

The Journal Section of the Council is incharge of the Editor who functions as *ex-officio* Secretary of the Editorial Board, of which the Director is the Chairman. The Editor is assisted by an Assistant Editor, and a small office staff.

Schemes for the planning of the following National Laboratories have been sanctioned by the Government of the Indian Union:—

1. National Chemical Laboratories, Poona.
2. National Physical Laboratories, Delhi.
3. National Metallurgical Laboratories, Jamshedpur.
4. National Fuel Research Institute, Dhanbad.
5. Central Glass and Ceramics Institute, Calcutta.
6. Road Research Institute, Delhi.

Of these the first five are in the process of erection and for the construction stage a nucleus staff has been provided for each one of them under an Assistant Director (Planning) who acts as the Secretary to the Committee and assists it in drawing up the plans.

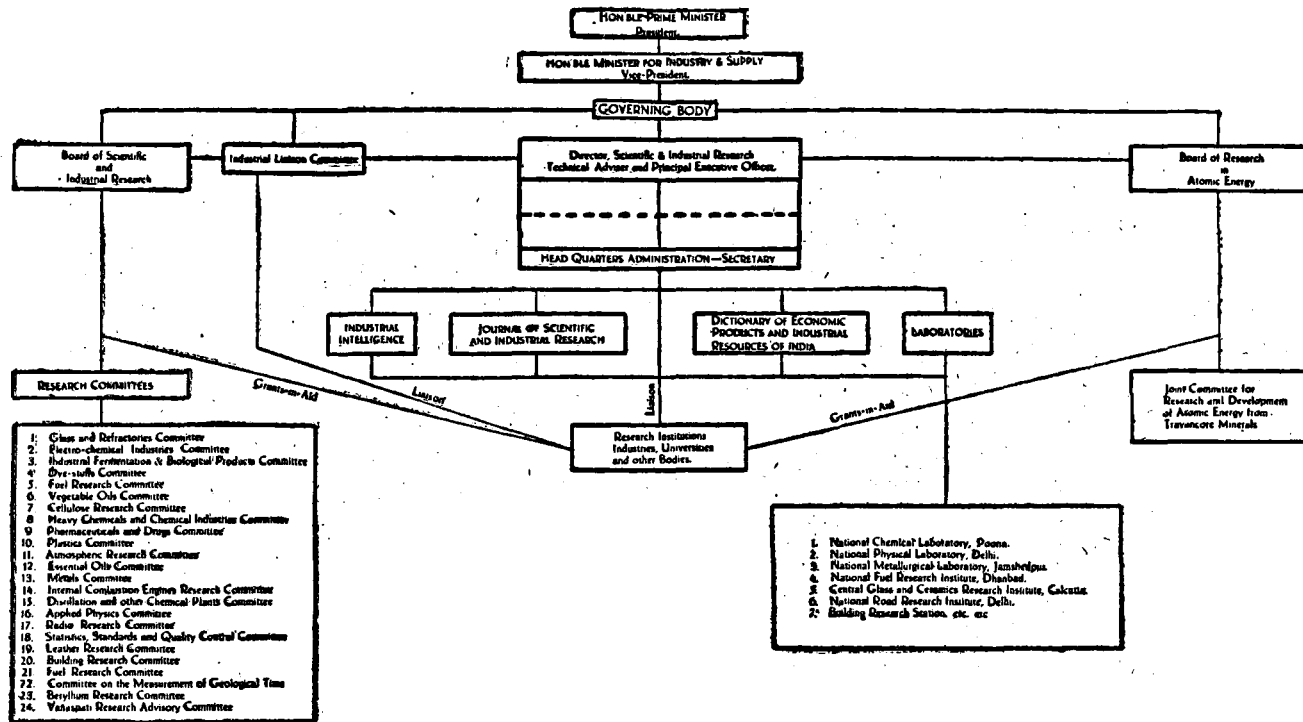
The nucleus of Building Research Station has been started under the auspices and with the co-operation of the Thomason Engineering College, Roorkee. An Assistant Director (Planning) for the Road Research Institute has been appointed and the Government has been approached for a site on the Muttra Road, Delhi.

There has also been appointed a Local Advisory Committee for each laboratory who scrutinises the detailed estimates, drawings etc. before tenders for the construction of the buildings are called for. The Local Committee also examines and makes its recommendations on the tenders after these have been scrutinised by the architects.

The planning section has been provided with a Drawings Officer and a small office staff. Professional advice for preparation of building plans and designs is obtained on payment of fees from approved firms of architects. The Director exercises general supervision over the activities of the Assistant Directors for Planning, both as the administrative head of the Council and as an *ex-officio* member of the various laboratory committees. The present administrative and research staff of the Council is shown in appendix and a schematic representation of the organisation of the Council in the diagram.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, INDIA.

Organisation.



Director for the National Physical Laboratories has been appointed and is at present in charge of the Physics section of the Council's Laboratories in Delhi. The Acting Director of the Chemical section has been selected as Director of the National Chemical Laboratories. Director, National Fuel Research Institute is in charge of the construction and the research work being carried on by the nucleus staff at Dhanbad. Director for the National Metallurgical Laboratories has been selected but has not yet joined his duties. A Director for the Central Glass and Ceramics Institute will be selected shortly, applications for the post having already been invited.

In addition to the national laboratories enumerated above, plans for establishment of a number of other national research institutes are in hand. These include (1) Central Drug Research Laboratories, (2) Food Technology Research Laboratories, (3) Electro-Chemical Industries Research Laboratories and (4) Leather Research Institute. Preliminary spade work with regard to the planning of these laboratories is in progress and Assistant Directors (Planning) for the Central Drug Research Laboratories and the Food Technology Research Laboratories are expected to be appointed in the near future.

ACTIVITIES

The present activities of the Council embrace a wide field and generally include (i) Scientific and Industrial Research, (ii) Utilisation and Development of Research, (iii) Survey, (iv) Intelligence and (v) Organisation, Planning and Setting Up of National Laboratories in different branches of Scientific and Industrial Research.

In addition to these Director, Scientific and Industrial Research is the Scientific Adviser to the Government of India and his advice on important scientific matters is sought for by the various ministries. This part of the duties of the Director, Scientific and Industrial Research constitutes an important and ever increasing part of his activities, which incidentally also adds to the importance and stature of the Council. Director, Scientific and Industrial Research is himself a member of many important committees and is represented on others by the officers of the Council.

The nature and extent of the activities of the Council as well as those of the Director, Scientific and Industrial Research are briefly described hereunder :

Research Activities

The main object for which the Board of Scientific and Industrial Research was created and which occupies a prominent place in the aims and objects of the Council of Scientific and Industrial Research is "the promotion, guidance and coordination of scientific and industrial research in India, including institution and the financing of specific researches". This object has been and is being fulfilled by the investigations conducted in the laboratories of the Council at the Delhi University and by the research schemes sanctioned by the various Research Committees at the different research institutions throughout the country under the grants-in-aid system.

Council's Laboratories, Delhi University

Directly after the creation of the Board of Scientific and Industrial Research, the laboratories and the staff of the Industrial Research Bureau at the Government Test House, Alipore, Calcutta, were placed under the direct charge of the Director, Scientific and Industrial Research. Early in 1942 with the entry of Japan into the war and the imminent danger to the city of Calcutta from aerial bombardment, the laboratories of the Director, Scientific and Industrial Research were transferred to Delhi and housed in the buildings of the Delhi University where they still continue

to function. The laboratories as well as the personnel were transferred to the Council of Scientific and Industrial Research when this body was created in March 1942, with the Director, Scientific and Industrial Research as the Director in addition to his other duties. The direct control of the Director, Scientific and Industrial Research continued till recently.

Early in 1944 with a view to relieve the Director, Scientific and Industrial Research for the important task of planning the development of the Council's organisation, the laboratories were divided into two sections—Physical and Chemical and were placed under the charge of two Acting Directors. The laboratories have been a live centre of research. Besides a planned programme of research, both fundamental and applied, under the auspices of the Council, numerous problems concerning the requirements of war were investigated in these laboratories in collaboration with the Department of Supply, the Royal Air Force, the U.S.A. Forces, the War Department and other Defence Organisations of the Government. The several problems successfully worked out largely reinforced the war efforts of the country on the scientific side.

Of the other research problems investigated in these laboratories, many have been leased out to various industrial firms in the country for commercial exploitation and the remaining are awaiting utilisation.

Several important process, viz., purification of Baluchistan Sulphur, Antigas Cloth manufacture, Vegetable Oil blends as lubricants, Pyrethrum Antimalarials etc., which were considered to be of direct help for the prosecution of the war were made available free to Government Departments and other interested parties.

The investigations at the Council's laboratories have proved to be of great significance in revealing the industrial potential of the country and utilisation of her resources in some fruitful and enduring lines. A detailed account of these researches is given in the paragraphs that follow.

Physics Section

I. PRODUCER GAS TEST PLANTS AND THE SEARCH FOR ALTERNATIVE FUELS (L. C. Verma, K. A. Nair, Das Gupta and M. L. Khanna.)

The acute shortage of petrol during the war for civilian consumption necessitated the running of motor transport on producer gas. To develop producer gas plants, a Master Testing Station was installed at the Council's Physical Laboratories at the Delhi University to guide and advise the routine testing of producer gas plants, which had been undertaken in

different testing stations in the country. In addition routine testing of more than one hundred plants manufactured in the Punjab, U.P., Bihar and Rajputana was also carried out. In collaboration with the War Transport Department, Government of India, a number of road tests were also carried out.

(a) *Standardisation of Filter Papers for Gas Purity Tests.* With a view to ensure the uniformity of results of bench tests at different testing stations in India, methods of standardisation of filter papers used for gas purity tests at various test stations were investigated and a standard filter paper was evolved which has now been adopted at all the testing stations in India.

Extensive tests on the flow of gases through filter papers were carried out with a view to correlating the physical characteristics of the filter paper with the flow of gases through it. A formula expressing these relations has also been developed.

(b) *Cleaning of Producer Gas.* Investigations on the suitability of fabric materials and felts for use in the final filters of producer gas plants have been completed, as a result of which certain varieties of drill and satin drill cloth have been recommended for use.

As regards the coarse filter media, experiments with various intensities of packing for cotton waste, coir, jute and other fibrous material are in progress to find out the best filtration medium and optimum packing conditions.

Operational difficulties and inconveniences encountered with different types of filtering material were studied. With a view to circumvent them and also to provide for wet scrubbing, which helps to eliminate corrosive impurities such as ammonia and sulphur dioxide, an improvised type of wet cyclone filter has been developed and patented. Dry cyclone filters have also been experimented upon.

(c) *Gas Purity and Power Tests.* As a result of gas purity tests on different makes of producer gas plants manufactured in different parts of the country, suggestions for improvements were given to the manufacturers, which enabled six different makes to bring up their plants to the standard prescribed for gas purity tests.

A dynamometer for carrying out the power tests has been constructed in the laboratory workshop and put in operation. Routine power output tests have been included in the regular schedule of tests required to be passed by all gas plants submitted for approval.

(d) *Experiments on Gas Plants.* A producer gas plant of the British Emergency type received from the Government Central Workshops, Kanpur, was tested with various filtering material with and without wetting agents on the original and modified filters. A detailed report on this subject was submitted.

(e) *Producer Gas Fuels.* For investigations on different varieties of Indian charcoal in relation to engine operation, laboratory bench tests were carried out.

Operation of vehicles on rectified spirit of 96% alcohol strength by volume and also on mixtures of producer gas and rectified spirit were studied under bench and road conditions. Successful methods for their use have been developed without much alterations in the petrol operated vehicle engine.

Experiments on the use of rice husk as a producer gas fuel have not yielded encouraging results.

(f) *Fuel Economy in Portable Producer Gas Plants.* Various methods for improving the fuel economy of portable producer gas plants such as gas-air-heat exchanger, exhaust gas injection, steam injection, were tried on the experimental truck. Of these gas air-heat exchanger was found to be very effective and was therefore recommended for general use.

Certain tests on proprietary brands of petrol savers were carried out at the instance of the War Transport Department with no useful results.

(g) *Clinker Formation in Gas Plants.* A peculiar type of trouble giving white clinker formation reported generally as taking place in various types of portable producer gas plants all over India was investigated and traced to the presence of barks in the wood used for the preparation of charcoal.

(h) *Engine Lubrication and Corrosion.* Corrosion by water-in-oil emulsions formed by the presence of moisture in producer gas and its mixture with lubricating oil has been studied. These emulsions lead to excessive corrosion and rusting of metal parts. Experiments to explain this behaviour have indicated that oil films are not impervious to the molecular diffusion of water. Work on the measurement of diffusion of water through oil films of various thicknesses is in progress. It has been found that the addition of extremely small amounts of certain protective agents to oil prevents the corrosive action of water, which may get emulsified with oil.

Demonstration trials with Nigo's oil cleaner have shown that used lubricating oils can be readily reconditioned.

(i) *Air Cleaner and Ventilation in Engines.* An improved type of engine air cleaning and crank-case ventilation system has been developed and patented.

II. VEGETABLE OILS AS FUELS AND LUBRICANTS. (J. S. Aggarwal, S. S. Bhatnagar, and L. C. Verman.)

(a) Indian vegetable oils were studied under prolonged runs as Diesel engine fuels. The results indicate that most of them such as groundnut oil, cotton seed oil may be successfully employed for this purpose, some without modifications in the engine except minor adjustments. Others, such as polong oil, may require certain engine parts to be built of corrosion resistant alloys. As compared with mineral Diesel oils, vegetable oils gave, in general, approximately the same power output, a slightly higher fuel consumption, better brake thermal efficiency and slightly more but not excessive deposits. The results are embodied in a bulletin (I. R. B. No. 19) and have been published for general use by all interested parties.

Extensive work was carried out on vegetable oils as lubricants. A series of Air Ministry Oxidation tests were undertaken on various oils, castor, groundnut, cotton seed and rapeseed, with and without stabilisers. A number of effective stabilisers were discovered for various oils and a few blends of different oils were developed and tested as lubricants for internal combustion engines. The results have shown that satisfactory vegetable oil blends could be prepared which would compare favourably with mineral oil lubricants in almost all respects. The results of this investigation were published in the form of a bulletin (I. R. B. No. 18 and 20) and are known to have been utilised by the oil companies.

(b) *Colloidal Fuel.* Preliminary experiments using vegetable oils with 35% charcoal have been successful but it would be necessary to develop production of very fine grade charcoal to reduce wear of the engine.

III. IGNITION LAG OF VEGETABLE OILS AS DIESEL ENGINE FUELS. (L. C. Verman and A. S. Bhatnagar.)

The work on the utilisation of Indian vegetable oils as fuels for Diesel engines "indicated that certain vegetable oils gave a better thermal efficiency than mineral Diesel oil and almost all vegetable oils gave thermal efficiencies higher than might be predicated from a knowledge of their calorific values. A detailed study of the combustion mechanism of vegetable oils in general and a determination of their ignition lags in particular

was undertaken. In the absence of a standard indicating equipment, ignition-lag of fuels in Diesel engines was measured by recording the time between injection and ignition. The latter was measured as follows: The ionised vapours undergoing combustion showed maximum electrical conductivity in the spark gap which was made a part of an electric circuit. To observe this a pre-amplifier was constructed and used with the oscillograph. A record of the ignition time as well as the injection time was obtained on a time base synchronised to the speed of the engine. A camera was used to obtain a permanent record.

In the course of the work on the ignition lag of oils in the Diesel engines it was observed that the electrical conductivity of the film of soot formed on the plug inserted in the combustion chamber, showed pressure sensitivity. This phenomenon was investigated and the results have been published.

IV. VEGETABLE OILS AS ILLUMINANTS. (J. S. Aggarwal, S. S. Bhatnagar and L. C. Verman.)

Suitable blends of vegetable oils with fusel oil have been evolved as substitute illuminants for kerosene which was in short supply during the war. The results have been published for general information.

V. STORAGE BATTERIES.

Comparative performance and life tests were carried out on foreign and Indian batteries. The findings were communicated to the various firms. During the war period certain amount of work was done on aeroplane batteries for the R. A. F.

VI. DRY CELL MANUFACTURE. (K. Subba Ramiah and L. C. Verman.)

A systematic study of the indigenous manganese ores and technique of manufacture was undertaken. Ores useful for use in dry cells were indicated to the manufacturers. The results have been published in the form of a bulletin.

In order to increase the output of cells, manganese ores in dry cell manufacture are generally admixed to an extent of about 10% with artificial manganese dioxide. This material under wartime conditions, was not available in India. A process which activates the natural ore to give outputs comparable with that obtained by the addition method and which is incidentally cheaper was developed and patented after semi-commercial scale trials. The process is leased for exploitation to Messrs. Estrella Batteries Ltd., Bombay.

VII. CARBON PRODUCT MANUFACTURE. (G. D. Joglekar, D. Sen and L. C. Verman.)

(a) *Electrodes for Dry Cells.* Considerable work on the production of carbon electrodes for dry cells was carried out and experiments to determine the extrusion characteristics using varying extrusion pressures and temperatures, different proportions of the body and binding materials and different shapes of extruding nozzles were conducted. The conditions for the baking of rods were studied and suitable furnaces for the same designed and constructed. A cyclone separator to control the particle size distribution of the body material was fabricated and suitable hydraulic presses manufactured. The completed process was revealed to Messrs. Estrella Batteries Ltd., Bombay for commercial development. The cyclone separator and magnetic separator developed have been patented.

(b) *Arc Carbons.* For manufacture of carbon arc rods, machine for filling up the cores of the cored rods with chemicals to give light of the desired characteristic was designed and fabricated. Conditions governing the copper plating of the carbon rods have been studied and suitable composition of the electrolytic bath has been evolved. Successful improved methods for calcining of petroleum coke, which has definite influence on the quality of the finished product have been studied. Work on other characteristics that effect the finished rods is still in progress. For the testing of arc carbons a projector has been fitted up. Measurement of brightness, crater temperature and speed of burning are generally carried out.

(c) *Carbon Brushes.* Suitable compositions for the manufacture of carbon brushes from coke, graphite and copper powder, and their admixtures giving suitable hardness, current carrying capacity and other requisite properties are being evolved. Apparatus for determining electrical resistance and scleroscopic hardness of brushes has been designed and assembled. Methods for connecting copper leads to brushes have been studied and the filling compounds analysed. Tests on motor generators with laboratory made carbon brushes are in progress. A testing laboratory machine has been fitted to test the voltage drop, wear and friction of the brushes under controlled conditions.

(d) *Carbon Microphone Granules* (L. C. Verman, G. D. Joglekar, and A. S. Bhatnagar.) A few Indian coals were tried for making granules, many of which were found to possess the requisite qualities in varying degrees but none of them gave satisfactory performance in the

microphone. So far, the Jangli Gali coal received from Jammu State has given the best performance. Further investigations are contemplated.

(e) *Microphone Diaphragms* (S. Banerji and L. C. Verman.) As an allied product to the carbon granules, carbon discs for use as diaphragms in carbon microphones have also been prepared and experimental microphones using these diaphragms were made in the laboratory workshop.

(f) *Welding Rods*. (L. C. Verman, G. D. Joglekar and D. Sen.) Welding rods prepared from petroleum coke were tried in the automatic welding machine and have shown very nearly the same speed of welding when using 300 amperes current as the commercial rods on the market.

VIII. **FUEL PUMP DIAPHRAGMS.** (S. M. Karim, K. K. Sarin and L. C. Verman.)

Fuel pump diaphragms used in motor cars were in short supply during the war, as they were imported. A substitute superior to the foreign imported variety was developed so that it could be equally useful for petrol as well as for alcohol petrol mixtures and was used in large numbers in the Far East theatre of war. The large scale production of these for civil and defence service requirements has been entrusted to Messrs. United Trading Co., Delhi.

IX. **PETROL PROOF RUBBERLESS HOSE PIPES AND TUBES.** (S. S. Bhatnagar, S. M. Karim and L. C. Verman.)

Owing to the non-availability of the usual rubber petrol pipe, rubberless products having flexibility and other characteristics necessary for such articles were developed and a successful composition for the same arrived at. Samples made in the laboratory were tested by the Burmah Shell Oil Company and the R. A. F. who submitted very satisfactory reports. In one reported instance, over 50,000 gallons of high octane-petrol were passed through these pipes over a period of 7 weeks without any signs of leakage or deterioration of the pipe whatsoever. Specifications for the pipe were drawn up by the Ordnance Laboratories, Kanpur and full details of the composition of the pipe have been released to the R. A. F. The question of releasing the process for the civilian requirements is being examined.

X. **PETROL, WATER AND OIL PROOF COATINGS** (S. S. Bhatnagar, P. Prakash and B. N. Sikka.)

Different petrol-proof, water-proof and oil-proof coatings for cardboard containers for varnishes, paints, boot polishes etc. have been developed

by processing shellac. The production was found useful and supplied in quantity to the American Air Force. The composition was used to give an internal protective coating to synthetic rubber lining inside the aircraft petrol tanks. This enabled the use of Indian petrols which have a high content of aromatics. This composition was also applied to plywood containers to render them petrol proof.

XI LAMINATED CONTAINERS. (S. S. Bhatnagar, P. Prakash and B. N. Sikka.)

Laminated containers from various types of material including fabrics, paper, jute, hessian etc. and resins of various description were made. In this class may be mentioned 2 gallon petrol containers and 75 gallon capacity jettison tanks for carrying petrol in aircraft. To make the process useful for manufacture on a cottage industry scale, the use of costly equipments was avoided.

XII. DROPPABLE CANVAS PLASTIC PETROL TANKS. (S. S. Bhatnagar, S. M. Karim, K. K. Sarin and L. C. Verman.)

At the instance of the U. S. A. Air Force authorities water soluble plastic powder composition from indigenous raw materials was developed for use under field conditions in impregnating, stiffening and petrol proofing droppable canvas tanks employed for the purpose of extending the flying range of air craft. The composition developed satisfied the specifications. The process of preparation and application was revealed to the U. S. A. Air Force.

XIII. UTILISATION OF WOOD WASTE. (S. M. Karim and K. K. Sarin.)

Saw dust, wood shavings and other similar wood waste products have been treated chemically, mixed with indigenous resins and plasticisers and pressed into sheet boards of the masonite type. The process is awaiting development on commercial scale.

XIV. IMPREGNATED WOOD PRODUCTS.

(a) *Jute Mill Bobbins.* (S. S. Bhatnagar, G. D. Joglekar, S. M. Karim and L. C. Verman.) Untreated jute mill bobbins break easily under service conditions and treatment to improve their resistance to breakage was considered desirable. After trial of several likely compositions, a suitable composition was developed and tested in a number of jute mills under actual service conditions.

The composition developed was found to be satisfactory. The process has been made available to all firms interested and representatives of some of the leasees were trained in the laboratories in the technique of the impregnating process.

Similar treatment of cotton mill bobbins is also under investigation.

(b) *Bamboo Strips for Weaving Combs.* (S. M. Karim, K. K. Sarin and L. C. Verman.) The object of the investigation was to reduce the flexibility of the bamboo strips by suitable treatment as the weaving combs prepared from the strips do not yield a uniform finish to the cloth produced due to their flexibility and thinness. Bamboo strips as well as finished combs were treated and on trial at the Government Textile Institute, Madras, were reported as follows :

“Treated bamboo reeds have been in use for sometime and are appreciated by the weavers.”

The process has been released to the Principal, Government Textile Institute, Madras, free of charge for utilisation in the handloom industry. He would also arrange demonstration of the process to weavers in various centres.

(c) *Bamboo Gramophone Needles.* (S. M. Karim and K. K. Sarin.) Gramophone needles made out of bamboo, to replace the steel ones were hardened by impregnation treatment. Treated needles gave very satisfactory results regarding tone. A needle could play 3 sides of a 10" record. It could be re-used again by sharpening the point with a special cutter.

XV. LAMINATED BOARDS.

Laminated products have been in use for many years past but with the growth of plastics industry, the importance of laminated material has considerably increased. Laminated products now find use in a large and varied field and involve the production of numerous types each suited to the particular application. All types must, however, possess certain properties in common such as a fair amount of mechanical strength, fair degree of resistance to wear and tear and to effects of weather, capacity for being machined or worked etc., apart from special requirements imposed in specific fields of application.

The supply of laminated products and particularly laminated boards was scarce during war time and this led to the present investigation, where attention has been confined to such materials as can be produced from raw

material of indigenous origin. A variety of products were developed by the use of these materials which showed remarkable resistance to heat and water. Patents were taken out to cover improvements in the process of manufacture of laminated boards and for the manufacture of corrugated laminated board, and assigned to various firms for exploitation.

In order to check the comparative quality of jute laminates, physico-chemical tests to determine tensile strength, shear strength, transverse beam strength, absorption tests on immersion in water, petrol, fatty oils, ghee, lubricating oil etc., and the changes produced in the physico-chemical properties by the above liquids as a result of the immersion of laminated products therein were conducted.

Special products were developed for certain specific fields of application.

XVI. DRAWN LAMINATED MOULDINGS. (B. N. Sikka, G. Singh and L. C. Verman.)

It is well known that plastic articles made from moulding powders do not have the necessary strength. Laminated sheets and boards, however, possess extraordinary toughness due to coordinated reinforcement of the fabrics. This idea was further extended to mould various types of articles from resin impregnated laminates. After considerable amount of experimental work it has been possible to mould various articles such as ash trays, cigarette cases and containers of different shapes and electrical accessories like ceiling roses, switches etc. Patents have been taken on this subject in India, U. K. and U. S. A.

XVII. HORN WASTE PLASTICS. (S. S. Bhatnagar, A. Jogarao and L. C. Verman.)

The object of this investigation was to find alternative uses for horn wastes which are plentifully available in the country. A composition using only indigenous and easily procurable ingredients which gave a practical and satisfactory moulding powder was developed. The moulding powder can be manufactured by dry mixing of the ingredients on hot rolls or by wet mixing in an aqueous medium and the mouldings have a variety of uses.

By degradation of the proteinous and resinous constituents of horn waste and chemical treatment of the resulting mass, it was possible to prepare a moulding composition similar to casein plastics. The results of the investigation were patented and have been leased out to a Coimbatore firm for exploitation.

XVIII. COFFEE BEAN PLASTICS. (S. S. Bhatnagar and B. N. Sikka.)

To find a useful outlet for surplus coffee beans, the investigation into the possibilities of utilising raw coffee for the preparation of moulding powders was undertaken and a moulding powder successfully developed. Alternative compositions eliminating the use of chemicals in short supply were later formulated and the mouldings so prepared possessed good water resistant and mechanical strength qualities.

The utility of cherry coffee husk, a waste from coffee beans, for treatment to yield plastic moulding compositions was also investigated and after a series of experiments a moulding powder was successfully developed from this material. This powder moulds into flat sheets and simple shallow designs. The moulded articles are tough, strong, resistant to water and can be polished and machined.

These investigations were conducted at the instance of the Coffee Planters Association of India. The industrial development connected with these are held up for the time being owing to the increased price of coffee having temporarily rendered the process uneconomical.

XIX. ARTIFICIAL WOOL FROM GROUNDNUT CAKE. (S. S. Bhatnagar and S. L. Kapoor.)

A systematic investigation on the separation of protienous matter from groundnut cake was made and the conditions of separation standardised. The spinning solutions were made up to a certain constant composition. From these the fibres were spun and after the usual hardening treatment their tensile strength was determined. Apparatus for tensile strength determination was designed and built. A pilot plant trial of the process is being conducted.

XX. ANTIGAS FABRICS. (S. S. Bhatnagar and Prem Prakash.)

For meeting the urgent demand of antigas cloth a formula for an antigas varnish using indigenous materials was developed and pilot plant experiments for large scale production of the same were perfected. The stringent requirements of the specifications demanded that besides being impervious to toxic gases, the antigas fabrics should also be waterproof to the extent that it should stand boiling water without any deterioration in any of its properties. It should, in addition, be highly flexible and soft to touch and yet sufficiently hard for the impregnating material not to be scratched away mechanically. Specifications regarding tensile strength and tackiness were also prescribed. All these demands were successfully met by the formula developed. This formula was made available to a large

number of firms to enable them to meet the huge requirements of the defence department. Technical help and assistance in ensuring large scale production was also given and it is estimated that more than one crore rupees worth of antigas cloth was produced during the war period.

To cover up the sewing machine holes, a special seaming varnish was developed and thousands of gallons of this varnish were used in the factories for the manufacture of antigas garments of different kinds. The use of this varnish ensured that no gas would leak through the sewing machine holes and injure the skin of the wearer.

XXI. CROWN CORK CEMENT.

A suitable adhesive for cementing cork sheet pieces to metal crown caps which are made of black lacquered iron was developed and released as technical advice to a Delhi firm.

XXII. CASEIN GLUES.

Investigations on the preparation of casein glues were carried out at the instance of the Indian casein producing interests to enable them to utilise the casein available with them. It was found that most of the formulations available in the literature do not yield really water proof joints demanded by the standard specifications. A composition, all the ingredients of which are indigenous, was evolved and was found to give the best results. Plywood boards made from this glue by the hot and cold pressing processes were both found to possess excellent water resistant qualities. The question of patenting the composition and utilising it on a commercial scale is under consideration.

XXIII. CAPPING CEMENT. (S. M. Karim and L. C. Verman.)

Capping cement for electric bulbs was developed from indigenous raw materials and the technical details were released free to the Indian lamp manufacturers.

XXIV. ULTRASONICS. (S. S. Bhatnagar, S. Parthasarathy and others.)

The work done on Ultrasonics covers a number of problems of pure and applied nature.

(a) The investigations relating to the modes of oscillation of quartz were directed to the determination of (i) the various frequencies at which

a quartz plate can oscillate, (ii) the oscillations along the different axes, (iii) the effect of damping due to the presence of superincumbent liquid column (iv) simultaneous oscillations at more than one frequency and (v) the oscillations produced by exciting the quartz by a carrier wave of complex wave form.

(i) It is known that a piezo-electric quartz plate can oscillate at its fundamental resonant frequency as determined by its thickness as also at a number of its odd multiple. As suggested earlier it was found that a quartz plate can oscillate not only as its odd harmonics but also at halves of odd, such as $3/2$, $5/2$, $7/2$ and even multiples of its fundamental frequency. These observations were subsequently confirmed entirely by Chinese workers, Tsien and Chu, working independently in the National Academy of Peiping (vide Nature October 6, 1945).

(ii) Study of oscillations along the different axes of a quartz plate was carried out. When an X-cut crystal having its facets electro plated with silver and copper was excited into thicknesswise vibrations at its fundamental frequency, it was observed that feeble oscillations are also present along the Y and Z axes.

(iii) It has been established that a piezo electric quartz plate can be made to oscillate simultaneously at more than one frequency. It has been also established that the complex diffraction pattern obtained in such a case is analogous to the case of two or more superimposed transmission gratings in optics. Another case of simultaneous oscillations was observed to occur in the case of zeichen or pulling up of the vibration frequencies of the crystal. In this case the diffraction spectra of the two frequencies are present independently. Recently this effect has been produced by exciting the quartz by two alternately pulsating carrier frequencies.

Diffraction produced by ultrasonic waves generated by a quartz plate fed with an amplitude modulated carrier has also been obtained. It is observed that in this case the high frequency lines are bracketed by secondary low frequency lines as in the case of super-position of two gratings but unlike the latter, the zero order line does not show any low frequency lines enclosing it.

The phenomenon of simultaneous oscillation of quartz at several frequencies has been utilised for developing a new method for the study of dispersion of sound velocity in liquids. This method which has been

evolved and used for the first time in these laboratories eliminates most of the error accompanying other methods. Investigation on certain liquids did not show any dispersion. Further work is in progress.

(b) Velocity and adiabatic compressibility have also been determined in a number of liquids with a view to finding out the possibility of a correlation between sound velocity and chemical constitution. The liquids studied include some vegetable, essential and mineral oils. This method has been investigated for determination of mineral oil content in paraffin wax-oil mixtures containing small percentages of oil.

(c) Similar to the method evolved for the study of dispersion a new method has been devised for the study of absorption of ultrasonic waves in liquids and its variation with temperature and frequency. Further work on study of liquids and solids and technical applications of ultrasonics is in progress.

XXV. MICA.

India is one of the largest producers of good quality mica in the world. The dielectric constant and power factor of representative samples from various parts of the country have been determined.

XXVI. BUILDING MATERIALS. (L. C. Verma and M. R. Verma.)

Samples of sandstone received from the Central P. W. D. were examined to determine the causes of the severe weathering in certain cases. The fault was due to an excess of lime in the stones and suggested a faulty association of material and transfer of lime from some lime-rich source to the sandstone by percolation etc.

Studies on burnt clay or surkhi as pozzolana and cement surkhi mortars and substitute for Leighton Bazzard standard sand were also conducted.

XXVII. PARTICLE SIZE STUDIES.

In many industries particle size studies of the raw material are important. A detailed study of these problems has been undertaken with particular reference to particle size distribution (i) in red lead pigments for paints and (ii) in clays for pencil manufacture and rubber article manufacture. Some theoretical work on the effect of container walls on packing density of particles was also carried out.

XXVIII. (i) METALLIC VACUUM CONTAINERS. (S. S. Bhatnagar and M. R. Verma.)

This problem was taken up at the instance of the Supply Development Committee and referred to the development of double walled metallic vacuum containers similar to the thermos flasks which are usually made of glass. Several technical problems such as the question of excessive heat conduction through the lid of the container, the technique of sealing off, degassing of the metal sheet, adequate strength of the walls, maintenance of vacuum over long periods of time, choice of the type of construction, whether deep drawn or all welded construction, the necessity of getters etc., had to be investigated for the development of these metallic containers. Thick coatings of silver have been found suitable. A copper to pyrex glass seal was prepared and the copper tube brazed with the outlet steel tube so that the sealing off might be at the glass and arrangements for an ultimate vacuum of 10^{-3} m.m. of mercury were completed. The most favourable temperature and the duration of degassing and the hydrogen treatment of the vacuum container and its better treatment are under investigation.

(ii) HOT FOOD CONTAINERS. (S. S. Bhatnagar and M. R. Verma.)

Improvements in the hot food container, as usually found in the market have been indicated. The complicated top lid was replaced by a plywood lid coated with bhilawan enamel. Cutting down of the rings was found to give appreciably better results. Introduction of a double chamber, the outer chamber being filled with hot water, also increased the utility of the vessel. The results were placed at the disposal of the Supply Development Committee.

XXIX. STERILIZING FILTER PADS. (N. K. Basu, C. A. R. Khan, K. Subbaramiah and L. C. Verman.)

To meet the urgent demand for filter pads intended to get bacteria free filtrates in bacteriological as well as pharmaceutical preparations, it was necessary to prepare similar pads entirely from material available in India. These pads were tested in different laboratories and gave very satisfactory results.

XXX. SOLID METAL POLISH. (S. S. Bhatnagar, S. M. Karim and A. N. Nayar.)

A composition was worked out incorporating certain chemicals and binding agents with a suitable white earth as filler. A solid metal polish for buff work was thus obtained. This gave satisfactory and comparable results, which have been leased out for commercial exploitation.

Chemical Sections.

I. PLANT ALKALOIDS.

(i) *Kurchi Alkaloids*. (S. Siddiqui, S. K. Vasisht, V. N. Sharma, V. N. Puri and M. H. Khalid). *Kurchi* bark is a highly valued drug in the indigenous system of medicine in the treatment of dysentery and tuberculosis. Seven new alkaloids from the bark and seeds of the plant have been isolated and their relationship with the main alkaloid "Conessine" established. A number of derivatives of these alkaloids have been prepared and the therapeutic action of some of these investigated. The investigation is in progress.

(ii) *Cassia Alkaloids*. (S. Siddiqui, V. N. Puri, V. N. Sharma.) This drug commonly known as *Chaksu* finds an extensive use in indigenous medicine for different ailments. The constitution of the active bases of the seeds and methods for the large scale production of the bases were studied and a number of derivatives have been prepared.

(iii) *Alkaloids of Stephania Glabra*. (S. Siddiqui and G. R. Chaudhari.) In view of the reputation of some of the *Stephania* drugs in the treatment of tuberculosis and asthma, an investigation into the constituents of *Stephania Glabra* (*Gindaru*) was undertaken; three alkaloids have been separated and a number of derivatives prepared. Preliminary experiments by Mrs. Osborn at the Sir William School of Pathology, Oxford show that one of the derivatives (*Gindarinine-nitrate*) possesses definite antibiotic action against *Staphylococcus*.

(iv) *Alkaloids of Rauwolfia Serpentina*. (S. Siddiqui and R.H. Siddiqui.) The isolation of five physiologically active bases has been reported and it has been shown that the alkaloids from the drug collected in the Dun valley are allied to but not identical with those obtained from Bihar. The Ajmaline series of alkaloids has been reported by Chopra and collaborators and by Raymond-Hamet at the Paris Pharmacological Institute to be depressants of the nervous system and stimulants of the straight muscles of the intestines. The drug has been recommended for inclusion in the Indian Pharmacopoeia and studies in the chemical constitution of its various alkaloids is in progress.

(v) *Holarrhena Febrifuga Bases*. (S. Siddiqui, S. C. Misra and V. N. Sharma.) This African drug has a reputation as a febrifuge and it is used as a substitute for quinine, besides having other medicinal properties.

Samples from different parts of Africa were obtained and active bases from these are being separated for a study of their physiological properties.

II. ESSENTIAL OILS.

(i) *Chemical Investigations on Kakra Singhi.* (Karimullah, V. Subba Rao and Uma Shankar.) The constituents of this drug, valued for treatment of cough, asthma, etc. have been separated into two crystalline compounds and an essential oil whose composition has been determined. Steps to have the therapeutic value of the oil assessed are being undertaken.

(ii) *Allium Sativum.* (S. Siddiqui, N.L. Datta and A. Krishnamurthi) As a part of a general scheme of investigations directed towards studies in the sulphur containing antibiotic principles of plant origin, a systematic reinvestigation of garlic was undertaken and the active principles have been separated by fractionation and partitioning. Two distinct active substances, one equally active against *Staphylococcus* and *B. Coli* and the other more active against *Staphylococcus* have been isolated. Further investigations are in progress.

(iii) *Nim Seeds, Blossoms, Root, Bark and Leaves.* (S. Siddiqui, C. R. Mitra, P. N Rao and S. Bhattacharya.) The conflicting character of the earlier investigations on the active constituents of nim suggested a re-examination of the same. A series of bitter constituents have been isolated from the oil and a process for the large scale production of Nimbidin, Nimbin (crystalline), Nimbidol has been evolved and a number of pharmaceutical preparations of Nimbidin standardised. Pharmacological tests and clinical trials with some of the derivatives by the King George Medical College and Hospital, Lucknow, have shown that these compounds are practically non-toxic and uterine contractive stimulants, others have been reported as being efficacious for skin diseases and others still have been found to provide a useful throat gargle as confirmed by the R. A. F. The industrial utilisation of the bitter constituents of nim oil is projected and apart from useful pharmaceutical products, the bye-products can be used in making soap, disinfectants, denaturants etc. This work has been reviewed favourably in the Chemical Trade Journal and Chemical Engineer, Great Britain.

In contrast with the derivatives obtained from the oil no bitter principles could be isolated from the nim blossoms while Nimbin was found to occur as such in the root bark of the nim plant along with Nimbidin and some other water soluble bitter constituents which are being investigated. A number of new substances have, however, been isolated from the

blossoms and form the subject of detailed study. It has also been proved that the absence of Nimbin in certain collections of seeds can be ascribed to variations in the state of maturity of seeds at the time of their collection. Two acidic bitter constituents (one of them water soluble) have been isolated from the leaves.

The chemical examination of the trunk bark and evaluation of the plant is in progress.

(iv) *Bakayan*. (Amir Chand, C.R. Mitra and S. Siddiqui). An investigation into the active chemical constituents of this plant which belongs to the same botanical order as nim has revealed that in contrast to the nim fruit, bitter constituents of bakayan are entirely absent in the kernel and occur exclusively in the pericarp which, in case of nim, is entirely free from the bitter principles.

III. PLANT COLOURING MATTERS.

(i) *Chemical Examination of Archu* (G.R. Chaudhry and S. Siddiqui). Two crystalline colouring matters have been isolated and shown to be resistant to alkalies. The possibility of their utilisation for colouring vegetable ghee is being investigated.

(ii) *Didymocarpus Pedicellata*. (R. C. Salooja, V. N. Sharma and S. Siddiqui). Studies in pedicinin, one of the colouring matters derived from this plant, have shown that it is capable of existing in two physically different modifications.

(iii) *Chemical Examination of Vitex Peduncularis*. (S.C. Misra, V. N. Sharma and S. Siddiqui). Investigations on the chemical constituents of the various parts of this drug, reputed for treatment of black water fever, have resulted in isolation of vitexin and a crystalline neutral fraction whose constitution is being studied. Chemical examination of the leaves is also in progress.

IV. INSECTICIDES, PYRETHRUM CONSTITUENTS AND PREPARATIONS.

(i) *Concentrated Extracts of Pyrethrum*. (S. Siddiqui and A. V. Subbaratnam). A suitable process for the manufacture of biologically stable higher concentrates of pyrethrum with the help of solvents available in India has been evolved as a result of investigations in these laboratories. The chemical estimations of pyrethrins in these concentrates was

subsequently corroborated by biological assay carried out at the Malaria Institute, India and the Biochemical Standardisation Laboratories, Calcutta. The process which has been patented is available for commercial exploitation and a non-technical note has been published in the Journal of Scientific and Industrial Research.

(ii) *Anti-oxidants for the Stabilisation of Pyrethrins.* (S. Siddiqui, A. V. Subbaratnam and V.N. Sharma). Pyrethrum extracts generally deteriorate on storage, particularly when they are of high concentrations and various antioxidants are used to stabilise them. It has been established that derivatives of *bhilawanol* can be employed to stabilise concentrated pyrethrum extracts and the use of these products for the stabilisation of pyrethrins has also been covered by a patent.

(iii) *Pyrethrin Stabilising Emulsifier for Pyrethrum Extracts.* (V.N. Sharma and S. Siddiqui). As a result of extended investigations conducted for the preparation of biologically stable sprays, an emulsifying composition has been evolved which is miscible in all proportions with pyrethrum extract and serves to activate and stabilise the pyrethrins in the emulsion-sprays prepared from it. The formula, which is covered by a patent, was revealed to the D.G., I.M.S. to meet urgent defence requirements and manufacture was initiated at the Medical Store Depot, Madras. The figures of the first years production indicate a saving of a few million rupees towards the cost of kerosene and pyrethrum extracts.

(iv) *Pyrethrum Creams.* (S. Siddiqui, C.R. Mitra and A.V. Subbaratnam). A semi-vanishing, mosquito-repellant cream containing kerosene extract of pyrethrum was evolved at the instance of the Malaria Institute of India, and manufactured by the D.G.I.M.S., during war for army use. Some of the creams which had broken due to shocks in transport during the hot season were successfully reclaimed and suitable modifications for ensuring stability of the cream under accelerated conditions of shock and heat have since been made. The process has been patented and a non-technical note published for commercial exploitation.

(v) *Subsidiary Constituents of Pyrethrum Flowers.* (A. V. Subbaratnam, P. P. Pillay and S. Siddiqui).

(a) Carotenoid pigments have been isolated from pyrethrum flowers and the concentration of β -carotene noted in the Journal of Scientific and Industrial Research.

(b) Studies in the subsidiary constituents of pyrethrum flowers, directed towards the isolation of the irritant principle have resulted in the separation of certain water insoluble phenolic fractions, which have not so far found any reference in the extensive pyrethrum literature. Investigations are in progress on the characterisation of these phenols.

(c) Some bitter constituents have been isolated from aqueous-alcoholic extracts of pyrethrum.

(vi) *Emulsifiers for the Preparation of D.D.T. Emulsion Sprays.* (S. Siddiqui and K.K. Chakravarti). A number of suitable emulsifying compositions were evolved with the help of Indian turpentine as one of the solvents and easily available emulsifying agents which give 25-30% stock solution of D.D.T. Information regarding the investigation was passed on to the Malaria Institute of India who are conducting extensive field experiments.

(vii) *Utilisation of Heavy Coal Tar Bases.* (N. Ghatak and S.P. Mitra). A number of samples of "cattle dips" have been prepared using different derivatives of the higher bases and tested against the common Indian 'tick' at the Imperial Veterinary Research Institute, Izzatnagar. The encouraging results obtained are being further investigated.

V. OTHER PLANT PRODUCTS.

(i) *Herpestis Monniera, Brahmi.* (S. Dutta and Karimullah). In view of the importance of the drug in the indigenous system of medicine, an authenticated sample of leaves and stems was examined and gave mannitol and a small amount of saponin; the elucidation of constitution is still in hand.

(ii) *Chemical Examination of Mango Blossoms.* (J. L. Bose and S. Siddiqui). With a view to study the feasibility of industrial utilisation of mango blossoms, a chemical examination of these has been undertaken and has revealed the presence of 15% tannin; 8.9% gallic acid has also been separated as a result of the action of mould, *Aspergillus niger* on aqueous extracts.

(iii) *Studies in the Constituents of Chana and Other Indian Pulses.* (S. Siddiqui, J. L. Bose and P. R. Bhandari). A study of the chemical constituents of sprouted chana (Bengal gram) was undertaken and three new crystalline products were separated from the sprouts. Identical products in a yield of about five times of that obtained from Bengal gram, were separated from the Kabli chana. Biochanin A was assigned the consti-

tution of 5,7 dihydroxy-4' methoxy isoflavone which has been confirmed by synthesis. Biochanin C has been established as a growth promoting substance. Work on the elucidation of the constitution of Biochanin B and C is in progress. Investigations on the germs of mung, urd, pea and soya-beans have also been carried out and small quantities of crystalline products have been isolated from them. Further work on the germs of other common Indian pulses is in progress.

(iv) *Chemical Investigations of Euphorbia Tirucalli* (Karimullah and R. Gopalachari). This plant yields a large amount of milky juice which on coagulation solidifies to a wax like mass. On analysis this was found to contain 52% resins, 24% of a crystalline compound and the rest a rubber-like substance, proteinous matter etc. Work on elucidating the nature of these compounds is being continued.

(v) *Chemical Examination of Euphorbia Antiquorum*. (Karimullah and (Late) R. K. Pillay). The coagulated latex from this plant was found to consist mostly of a resin and a crystalline ester. Work on the elucidation of the nature of these compounds and the possible utilisation of the resin is in progress.

(vi) *Utilisation of Latices Obtained from Euphorbiaceae*. (Karimullah, R.G. Khalsa and Parkash Narain). The resins obtained from the latices of these plants have been treated with sulphur, formaldehyde, phthalic anhydride and other similar substances and some of the modified products obtained have been proved as satisfactory for moulding articles, laminated material, varnishes and as plasticisers. On chlorination a product which makes textile material fire and water repellent was obtained. The results have been protected by patents.

(vii) *Chemical Investigation of Gum Euphorbium*. (Karimullah and Parkash Narain). When chromatographed through a column of fullers' earth, the neutral portion from gum *euphorbium* yielded two crystalline substances which have been found to be different from the compounds isolated from other varieties of *Euphorbia* by Newbold and Spring.

(viii) *Rubber from Cryptostegia Grandiflora* (S. S. Bhatnagar, Karimullah and Uma Shanker). Investigations were undertaken at the instance of the Supply Department to find an easy, workable method to extract rubber from this plant which has assumed more than wartime importance in U.S.A. and other countries as a secondary source of rubber. Modified tapping and plug collection methods having been found cumbersome and

uneconomical, new avenues were explored and two separate processes have been worked out for the extraction of rubber from twigs and leaves, 90-99% of the actual rubber content being recovered. The processes have been patented.

(ix) *Tannins, Natural.* (P. Shankaramurthy and S.S. Bhatnagar). Kino of *Pterocarpus* and Kino of *Myria Naji*, galls of *Tannarix gallica*, the pods of *Wagatea spectata* have been found to be all good tans comparable with imported wattle bark for use in the leather industry.

(x) *Pectin Content of Plant Materials.* (I. J. Babbar and Bashir Ahmad). Pectin content of 30 plants from Delhi have been studied and pure pectin prepared from these.

(xi) *Chemical Examination of Babchi* (K. K. Chakravarti, A. K. Bose and S. Siddiqui). A new crystalline lactone has been isolated from the pericarp of the babchi seeds and its constitution is under investigation.

VI. VEGETABLE OILS.

(i) *Fatty Oils from Mimosa Pudica and Sisymbrium Irio* (J. S. Aggarwal and Karimullah). The characteristics of the fatty oils from these two seeds have been investigated and their unsaponifiable fractions examined. Further work is in progress on the two sterols separated.

(ii) *Fatty Oils from Mallotus Philippensis Muell.* (J. S. Aggarwal and Karimullah). The drying oil from this seed was extracted by solvent extraction and examined. The separation of the total fatty acids by the usual process was not possible as the acids have a great tendency to polymerise. A preliminary investigation on the film from the oil has been made and further work is in progress.

(iii) *Effect of Storage in Indian Vegetable Oils.* (J. S. Aggarwal). Changes in various refined vegetable oils and fats brought about as a result of storage in glass, tinned steel and plain steel containers have been studied. Oils in plain steel containers are more easily discoloured and oxidised than in tinned steel containers, glass is the best container. Surface of the oil exposed to air has a marked influence on oil deterioration.

VII. RESINS AND WAXES.

(i) *Chemistry and Applications of Indian Oleo-resins.* (A. K. Bose, K. K. Chakravarti and S. Siddiqui). Attempts have been made to work out a simple and economic method for the preparation of L-abietic acid from

rosin under the mildest possible conditions and it has been possible to arrive at a method for the transformation of the primary rosin acids without any application of heat and thereby ruling out the possible formation of pyroabietic acid. Further evidence has been brought forward against the theory of the occurrence of primary rosin acids as anhydrides. Further work is in progress.

(ii) *Abietic Acid from Indian Rosin.* (N. Ghatak and S. P. Mitra). By progressive steam distillation of rosin at a temperature above 200° C practically pure abietic acid distilled over. The process awaits large scale development.

(iii) *Bhilawan Shell Liquid.* (S. Siddiqui). A number of processes have been worked out for converting bhilawan shell liquid into non-vesicating semi-solid to solid products which can be utilised in the manufacture of lacquers, varnishes, enamels, insulating material and moulding plastics. The shell liquid has also been employed for the regeneration of rubber waste for the production of hard (ebonite substitute), semi-hard and soft rubber goods. Cracking of the shell liquid and subsequent fractionation of the cracked product has led to the isolation of catechol, a series of unsaturated hydrocarbons and lower phenols. The phenolic constituents can be employed for the manufacture of syntans which serve as valuable adjuncts to vegetable tannage.

As bhilawan shell liquid was not a commercial commodity, a special plant was designed and constructed for its large scale production. An improved process for the expulsion of the shell liquid by exposing the nuts to superheated steam has resulted in the production of a shell liquid comparable to the solvent extracted material.

Bhilawan stoving enamel has been under commercial production since 1942. The enamel can be sprayed or applied with a brush by dipping to give exceptionally glossy, hard, elastic and tenacious films without the addition of any pigment or admixture with drying oil or resin on stoving for 2 to 3 hours. The enamel film is resistant to weather conditions and is unaffected by boiling water, organic solvents and strong acids. In addition, a whole range of other stoving enamels has been obtained by modifying the bhilawan resin with certain vegetable oils, bitumen, asphalt and pitch. These enamels are comparable to other enamels and have a low cost of production.

Air drying varnishes in various shades and colours have been produced from resins obtained from co-polymerisation of bhilawan shell liquid with easily available indigeneous raw material. One of the compositions has been found suitable as an above-ground anti-termite varnish.

Various compounds have been evolved for moulding powders with resins produced from bhilawan shell liquid as binders. The moulded articles are comparable to bakelite in respect of heat and electrical insulation, water absorption and machinability. The commercial exploitation of these moulding powders is under consideration.

An ebonite substitute has been developed by regenerating hard rubber from whole tyre waste with bhilawan shell liquid and has been found satisfactory for commercial production.

(iv) *Cashew-nut Shell Liquid*. (S. Siddiqui). Cashew-nut shell liquid which could not find adequate use in India was being exported to America where it had been established as a starting material of exceptional value for the plastic industry. Recently a process for the expulsion of cashew-nut shell liquid from the shells and nuts has been patented wherein a yield of 95% is obtained. To utilise the cashew-nut shell liquid a process for its conversion, in combination with varying proportions of bhilawan shell liquid into semi-solid to solid resins has been worked out and patented. The resins obtained through this process have been utilised for the production of enamels, varnishes, water-proofing compositions, moulding powders etc.

(v) *Thermal Degradation Products of Naturally Occurring Resinols*. (R. P. Rastogi, V. N. Sharma and S. Siddiqui). Investigations of the neutral fraction obtained through the thermal degradation of bhilawanol has revealed that the fraction consists of a mixture of $C_{10}H_{20}$, $C_{11}H_{22}$, $C_{12}H_{24}$, $C_{13}H_{26}$ and $C_{14}H_{28}$ hydrocarbons on oxidation yield acetic, caprylic, capric, lauric, oxalic and succinic acids.

(vi) *Chemotherapeutic Studies in Bhilawan*. (A. Kamal, V. N. Sharma and S. Siddiqui). A number of new derivatives of bhilawanol, including sulphionate, arsenic compound, sulphonamide derivatives etc. have been prepared and found to be free from vesicating action with the exception of arsenic derivatives. Preliminary investigations on *B. Coli*, *B. Pyogenes*, *Staphylococcus*, *Streptococcus* and *Pneumococcus* indicate that germicidal effect of some of the derivatives is much more marked than that of bhilawanol. The arsenic derivative has a strong vesicating action on the human skin but the product itself is ineffective in preventing the growth of

bacteria. The process for sulphonation of bhilawanol and other similar material has been responsible for their use as syntans.

(vii) *Tanning Material from Bhilawan and Cashew nut Shell Liquids.* (M.A. Ghani, N. B. Desai and S. Siddiqui). The sulphonated products from these liquids on condensation with formaldehyde were employed alone as well as in conjunction with vegetable tanning materials for the tanning of hides. The results show that suitable products from the shell liquids are obtained only when the sulphonation and condensation is carried out with incorporation of their thermal degradation products or of lower phenols like cresylic acid in certain proportions but the thermal degradation products of the shell liquid can be utilised as such. Cashew-nut syntans appear to give a harsher leather than that obtained with the corresponding bhilawan product.

(viii) *Chlorination of Rubber.* (Karimullah and Uma Shanker). A method for the production of chlorinated rubber from partially cyclised rubber by chlorinating a 20% solution of it has been developed and patented. Transparent sheet laminated products, waterproof cloth etc. have been prepared from this product.

(ix) *Cyclisation of Rubber.* (Karimullah and Uma Shanker). Investigations on new cyclisation processes and new cyclising agents have shown sodium thiosulphate to be a good mild cycliser while partial cyclisation has been carried out with phenol and sulphuric acid in much smaller amounts than usual. The process has been patented.

(x) *Castor Oil, Sebacic Acid and Nylon Type of Resins.* (Karimullah, Ranveer Singh and J.P. Varma). Castor oil is degraded into sebacic acid and condensed with glycerol to obtain various types of resinous products, their nature and use depending upon the stage of polymerisation. Octyl alcohol, another by-product of castor oil degradation was used in the preparation of octyl sebacate, a plasticiser. With phenol, octyl-phenol which is considered to be a very desirable ingredient for certain thermo-setting resins was prepared.

(xi) *Bagasse.* (S. S. Bhatnagar, Parkash Narain and G. B. Tewari). A resinous mass is obtained by digestion of bagasse with water in acidic or alkaline media under pressure, straining the liquid and refluxing with spirit. The resin has good binding and water proofing properties and can be used in the manufacture of laminated articles, spirit varnishes, water proof fabrics, enamels etc. The method has been patented.

(xii) *Chlorinated Waxes from Naphthalene.* (S. S. Bhatnagar, N. Ghatak and Karimullah). In view of the availability of raw material and the wide range of industrial applications of chlorinated naphthalene, the conditions for their manufacture were investigated. It was found that there is more absorption of chlorine in a discontinuous cycle than in a continuous cycle and anhydrous ferric chloride is the best catalyst. Naphthalene in the fused state should be used in preference to solution. The black chlorinated products yield light yellow solid waxes when distilled in vacuum.

VIII. BIOCHEMICAL INVESTIGATIONS.

(i) *Nutritive Requirements of Yeast and the Production of Nutritionally Potent Strains.* (P. N. Vohra, K. L. Dhama and Bashir Ahmad). Two types of *Seccharomyces Cerevisiae* and two of *Torula Utilis* have been intensively studied with respect to their nutritive requirements for carbon, nitrogen minerals and vitamins. An optimal concentration for each of the vitamins *i.e.*, thiamin, nicotinic acid and riboflavine, after which there was a marked inhibition, was located at which growth to the extent of 10 times the control was noticed.

Based on this work, a simple method for the estimation of thiamin has been worked out using an adapted strain of *Torula Utilis*.

Some work on the manufacture of food yeast and the various problems involved has been undertaken and a pilot plant for the manufacture of yeast has been erected.

From feeding experiments, some evidence to show that children receiving supplements of yeast were excreting more uric acid than the controls has been obtained.

(ii) *Studies on Ascorbic Acid.* (Bashir Ahmad, A. A. Qureshi, M. R. Toosy and I. J. Babbar). The state of ascorbic acid as it exists in various plant tissues, and the amounts of free, dehydro and combined ascorbic acid as assessed by different methods have been determined in a large number of plants. The metabolic studies have included an investigation of the excretion of ascorbic acid in 140 persons of different ages and in different conditions of health and disease. The effect of a number of factors involved in the biosynthesis of ascorbic acid in germinating seedlings has also been investigated.

(iii) *Studies on Ascorbic Acid.* (I. J. Babbar and Bashir Ahmad)

(a) Experiments on extraction of ascorbic acid from plants have been carried out and oxalic acid as extractant is recommended. The results are being published in the *Annals Biochemistry and Experimental medicine*.

(b) Synthesis of ascorbic acid by germination of cereals and the effect of sunlight and manganese on the process has been investigated. The results have been published in the *Journal of Scientific and Industrial Research*.

(iv) *Growth Promoting Factor in Bengal Gram.* (S. Siddiqui, J. L. Bose, Krishna Murti and K. Bhagvat). Investigations on albino rats receiving a basal diet containing all the known nutritional factors to which were added supplements of various fractions of germinating Bengal gram were initiated. In the preliminary experiments the germ, alcoholic extract of the germ and Biochanin C have given positive results indicating that a new growth promoting factor is present in the germ. The effect of Biochanin C on the growth of simple plant bodies like yeast (*Saccharomyces cerevicie* and *Torula ultis*) and *Penicillium notatum* (Fleming) has also been studied and a 100% increase in the growth of yeast was recorded. In the case of *Penicillium notatum* the increase is 30% but the amount of penicillin produced was not affected.

(v) *Carotenoid Pigments and Vitamin A Potency of Plants.* (Bashir Ahmad and J. C. Sardana). A series of investigations on the carotenoid pigments of common edible plant tissues, involving the method of chromatographic separation, colorimetric estimation and identification by their absorption spectra and other physical properties has been initiated. The quantities and characteristic of these pigments present variation from species to species and the vitamin A potency also varies. Investigations on the metabolism of carotenoids in developing plant tissues, the phenomenon of isomerisation, occurrence and formation of the more important pigments are being continued.

IX. ORGANIC CHEMICALS.

(i) *Citric Acid from Citrus Fruits.* (N. Ghatak and Karimullah). Citric acid was obtained from Assam and Bengal lemons but on account of the higher cost, the possibility of a commercial manufacture was precluded except in lemons from Bihar.

(ii) *Agar—Agar*. (J. L. Bose, Karimullah and S. Siddiqui). It has been shown that *Gracilaria lichinoides* obtained from Travancore is sufficiently rich in agar-agar to form an economical raw material for its large scale production in India. A new and inexpensive method has been worked out for the purification of *Gracilaria lichinoides* from Travancore and to obtain bacto-agar of a quality which fully complies with B. P. and U. S. P. specifications.

(iii) *Furfural*. (Karimullah and R. G. Khalsa). Furfural has been obtained from rice bran, maize bran, rice husk, bagasse, paddy straw and corn-cobs. The economics of the process are being worked.

(iv) *Phthalic Anhydride*. (S. S. Bhatnagar, N. Ghatak, Karimullah and S. P. Mitra). A pilot plant has been developed and is working at Shalimar Tar Products (India) Ltd. The anhydride is produced by controlled oxidation of naphthalene and the optimum conditions for its working have been determined.

(v) *Vapour Phase oxidation of Indian Turpentine* (Karimullah and R. G. Khalsa). A suitable apparatus and technique for carrying out the catalytic vapour phase oxidation of Indian turpentine and its various fractions has been developed. Work to increase the yield and to determine the nature of the oxidation product is in progress.

X. INORGANIC CHEMICALS.

(i) *Manufacture of Soluble Barium Salts from barytes*. (S. S. Bhatnagar, S. Parthasarathy and A. L. Sundara Rao). The preparation of barium chloride has been effected commercially by evolution of a new method which has been put on a large scale by Mettur Chemical and Industrial Corporation, Mettur (S. India). Barium chloride of 99.94% purity is obtained and 190 lbs. of sulphur per ton of barium chloride is produced as a by-product.

(ii) *Recovery of Titanium Dioxide from Bauxite Sludge*. (S.S. Bhatnagar, S. Parthasarathy, G. C. Singh and A. L. Sundara Rao.) The general principles underlying the manufacture of titanium dioxide have been reinvestigated to determine the optimum concentrations and a pilot plant with a production capacity of 20 lbs. of titanium dioxide per day has been designed, constructed and tried. Titanium oxide of very high purity (99.56%) and fairly good pigmentation properties has been recovered.

(iii) *Ammonium Nitrate*. (S. S. Bhatnagar and Prakash Narain). At the instance of the Master General of Ordnance, the manufacture of ammonium nitrate has been investigated. It was found that reaction does not proceed strictly in accordance with the simple chemical equation governing the reaction between ammonium sulphate and potassium nitrate and fractional crystallisation as such could not effect complete separation of the two salts. Better yields could be obtained by increasing the concentration of ammonium ion in the reacting solution. This was also found economically suited for large scale production.

(iv) *Zinc Sulphate and Zinc Oxide*. (L. S. Chandrakant). Zinc slime, a waste bye-product in brass foundries, was converted into the sulphate by treatment with sulphuric acid. Iron was removed by hydrolytic precipitation at a favourable pH and copper by electrolytic precipitation by another metal higher in the electrochemical series. The zinc sulphate thus obtained was chemically pure. Zinc oxide was prepared from this by first precipitation as zinc carbonate and then decomposing the carbonate into zinc oxide.

(v) *Vanadium Compounds*. (Karimullah, R. Gopalachary and Pattabiraman.) The vanadium ore is finely powdered, mixed with sodium chloride in excess and roasted at controlled temperatures for a specified time. The roasted material is extracted with water and the crude ammonium vanadate is recovered by saturating the lixiviated liquor with ammonium chloride. If the roasting is carried out under slightly oxidising conditions by using a small amount of potassium nitrate, a great improvement in the yield of vanadium salts can be obtained.

(vi) *Utilization of Sodium Sulphate Bye-product of Dichromate Industry*. (A. L. Sundara Rao and D. S. Tandon). To sell this by-products to textile and paper mills it should be rendered free from chromium. A successful method for purifying the sodium sulphate obtained as a bye-product in the manufacture of dichromate has been developed and is awaiting utilization.

(vii) *Purification of Borax*. (A. L. S. Rao and D. S. Tandon). Methods have been evolved for purifying borax from Jagadhri (Punjab).

(viii) *Ultra-marine Blue*. (A. L. S. Rao and D. S. Tandon). Experiments are in progress regarding use of indigenously occurring bentonite, kaolin and other earths for the manufacture of ultra-marine blue.

II. MISCELLANEOUS INVESTIGATIONS :

(i) *Air Foam Solutions.* (Atma Ram, S. S. Bhatnagar, A. Jogarao, Karimullah and L. C. Verman). Supplies of air foam solution which were imported into India from abroad were cut off during war time and investigations were undertaken to provide this store which in cases of emergency is indispensable for protecting oil installations and putting off fire. Degradation products of proteinous matter were found by far to give the maximum amount of foam. The degradation is carried out under controlled conditions, the resulting hydrolysed solution concentrated and sterilised. The process was patented and leased out for commercial exploitation besides free permission being accorded to several oil companies to manufacture the foam for use at their own installations. More than a lakh gallons of the material are known to have been manufactured to meet defence requirements.

(ii) *Tin Lining Compounds.* (S. S. Bhatnagar, Karimullah, G. S. Tewari and Uma Shanker). Investigations have led to the formulation of a compounded latex containing 25-30% fillers which gives a tough elastic film inert to vegetable ghee and meeting the other requirements of tin lining compounds. The formula has been released for large scale production to a Deihi firm.

(iii) *Anti-scatter Treatment for Glass.* (N. Ghatak and Karimullah). Investigations were undertaken with the object of giving anti-scatter treatment to glass to prevent the falling or flying off broken glass fragments due to blast created by the explosion of high explosive bombs. Adhesives prepared from gum arabic and glycerol preserved with commercial phenol or cresol have given good results for pasting paper while a composition prepared from chlorinated rubber has given satisfactory results for pasting textiles.

(iv) *Modified Coal Tar Pitch.* (N. Ghatak and S. P. Mitra.) Due to the shortage of bitumen, attempts were made to modify the properties of coal tar pitch suitably so as to replace bitumen specially in the manufacture of roofing felt and roofing pitch and plastics. Medium hard coal tar pitch was blown with air at elevated temperatures in the presence of catalysts and plasticisers and compounded with fillers. Satisfactory outdoor exposure test results were obtained with samples of roofing pitch. Pitches were also prepared for manufacture of which roofing paper, roofing felt etc.

(v) *Examination and Utilization of Wood Tar.* (S. Siddiqui and I. K. Kackar.) Wood tar obtained from the Fertilizer and Chemicals Ltd., Travancore during manufacture of producer gas by distillation of wood has been examined. This tar on distillation yields 44% of an oily liquid leaving 38% pitch. Research on the utilization of this oily distillate in preparation of varnishes is in progress.

(vi) *Use of Indigenous Micaceous Iron Ore as Pigment.* (N. Ghatak.) A method to purify the ore and make it suitable for use in paints was developed and paints formulated with the indigenous micaceous iron ores, panels prepared from them being subjected to natural and accelerated artificial weather tests.

(vii) *Aeroplane Dopes.* (N. Ghatak and R. Bhattacharya.) Nitro cellulose lacquers, which are used as aeroplane dopes, were prepared from waste film dissolved in power alcohol containing a plasticiser and a synthetic resin. Tests at the Ordnance Laboratories, Kanpur and the Govt. Test House, Calcutta proved satisfactory and the dope gave satisfaction even after 150 flying hours test. The process has been released for commercial exploitation.

(viii) *Ground Nut Products.* (D. C. Dhar, W. V. Kotasthane and S. Siddiqui.) Sulphonated products from ground nut oil castor oil mixtures with or without the addition of cashew-nut and bhilawan shell liquids, have been noted to have an important application in the vat liquoring of leather and can be used directly with the advantage that the treated leather has a higher tensile strength and finer feel. Groundnut oil has been co-polymerised with bhilawan shell liquid and turpentine resulting in the production of a valuable resin. A modified resin has also been prepared by the incorporation of another resin in the process of co-polymerisation. These co-polymers form a soft semi-solid to solid mass soluble in benzene, turpentine and white spirit and yield a varnish. The resin is also useful for water proofing textile fabrics such as poplin, long cloth, jute, canvas etc. The varnish has also been found to be of use for imparting a leather finish or wrinkle to textiles.

When mixed with nitro cellulose in suitable solvents, groundnut bhilawan varnish, yields a lacquer, which has good adhesion, gloss, scratch hardness and a supple feel when coated on leather.

(ix) *Salad Oil.* A process has been developed for treating groundnut oil with high temperature steam, under certain experimental conditions

to give a nearly neutral clarified oil free from the characteristic ground-nut oil odour.

(x) *Lignite Coal.* (Mahendra Swarup and S. S. Bhatnagar). A resin has been obtained by solvent extraction of lignite from Bikaner State and utilised for production of plastics and varnishes. A moulding powder with good surface finish, tensile strength and flow was formulated by employing the extracted resin in combination with depolymerised lac and jute and other agricultural wastes as fillers. In combination with drying oils, the lignite resin was used for the preparation of water and gas proof varnish. A dope was also prepared from the resin which renders the cloth used for balloons hydrogen proof. The reports of tests carried out at the American Air Headquarters, Agra at whose instance the investigation was carried out, were very favourable. The dewaxed and deresinified lignite with 5% pitch or bitumen as binder yields briquettes.

(xi) *Fluxes for Welding Aluminium.* (S.S. Bhatnagar and A.L. Sundara Rao). In view of the general scarcity of cryolite and other fluorides, investigations were undertaken with a view to develop a flux composition from entirely indigenous raw materials and having comparable welding characteristics. Samples from the new flux developed have shown on tensile strength tests on the world that the new flux is in no way inferior to imported fluxes. The process has been patented.

(xii) *Signal Smokes and Flares.* (S. S. Bhatnagar, L. S. Chandrakant and A. L. Sundara Rao.) At the instance of the M. G. O. and Civil Defence Departments, successful formulae have been evolved for yellow, red and blue smokes possessing nontoxicity, high density, low rate of burning and pronounced colour and stability. A workable formula has also been evolved for red flares. The formulae were revealed to a contractor for supply to meet government requirements.

(xiii) *Transparent Papers.* (N. Ghatak and S.P. Mitra). Investigations on the manufacture of continuous films of cellulose were undertaken at the instance of the R.A.F. who required transparent tapes 3" wide and 300 feet in length from salvaged wind screens of aeroplanes, pilot plant to produce films of different thickness required was constructed. This pilot plant is capable of producing cinematograph films and cellophane papers from various resin solutions.

(xiv) *Cork Substitutes.* (S. S. Bhatnagar and Ali Anmad). The waste from rejected bamboo strainers after a preliminary treatment when mixed with suitable binders like blown linseed oil or castor oil and fillers gives

products which could be easily bored and are tough without loosing their flexibility and are weather resistant, the characteristics required for cork substitutes. The process has been covered by a patent.

(xv) *Shock Resistant Packing Material.* (S.S. Bhatnagar, A. Ahmed, and V. S. Bhatia). The experience acquired in the development of corks substitutes was utilised in making sponge-like products and flexible sheets of varying porosity. Stiffer varieties are used as packing material while another variety evolved using animal hair with rubber binders has proved to be of use where resistance to shock is required, is light, flexible and springy. The animal hair could be substituted by coir fibres without impairing the qualities of the product. The process has been patented.

(xvi) *Sintered Glass.* (Bh. V. Jankirama Rao). In view of the ever widening application of sintered glass both in the laboratory and industry experiments were undertaken in these laboratories to manufacture them from some type of resistance glass manufactured in India. Articles of any shape, flat, concave, convex, thimbles, crucibles, pots etc. of different porosities can be made by this process which has been covered by a patent.

(xvii) *Water and Grease Proof Paper.* (Karimullah and G. S. Tewari). Samples of butter and wrapping paper for general use were made and tested at the Central Food Laboratories, Kasauli and found satisfactory. The process has been patented.

(xviii) *Water and Fire Proof Cloth.* (Atma Ram, S. S. Bhatnagar, Karimullah and C.A.R. Khan). After extensive investigation a composition based on the use of chlorinated products from indigenous resins has been developed and patented. The composition when applied to cloth makes it non-inflammable and water resistant.

(xix) *Hydraulic Fluids.* (J. S. Aggarwal, S. S. Bhatnagar and L. C. Verman). Fluids for use in hydraulic mechanisms have been developed from refined castor oil with the addition of small amounts of stabilizers and other ingredients. The patented process has been leased out to the Indo-Burma Petroleum Co.

(xx) *Thickened Fuel for Flame Throwers.* This investigation was initiated with the object of replacing aluminium stearate which is used to thicken the fuel in incendiary bombs. Suitable substitute soaps were prepared and the conditions for their large scale production standardised. Substi.

tutes for the phenolic bodies which are other main constituents of these bombs were also developed from bilawan shell liquid and cashew-nut shell liquid. The results of the investigations were made available to the Supply Development Committee.

(xx) *Water Detecting Composition.* A suitable material was produced for the detection of water in petrol containers and was found to be much superior to the imported product. It can be employed for detecting the depth of water below petrol, vegetable oils, heavy machinery or lubricating oils, hydrocarbons etc. A patent embodying the results of the investigation has been taken out and the development of the process was entrusted to the Supply Development Committee. Specifications have been drawn up by the Chief Inspector of Stores and Clothing, Kanpur.

At Universities and Research Institutes

In addition to investigations undertaken in the laboratories of the Council itself, a large number of research schemes from various investigators have been worked out at the different centres of scientific research at the instance of the Council and financed by it. These cover a variety of problems having important bearings on increasing the country's industrial potential.

The paragraphs below contain a brief account of the work being done at the more important centres.

Besides industrial utility, many of these schemes have yielded results of interest to the scientific world which form the basis of many important contributions to technical journals. A list of these is included in Appendix IV. Incidentally some of the investigations have enabled the investigators to improve their educational qualifications by including the results of the investigations, with the permission of the Council, in their M.Sc. and Ph.D. thesis.

THE INDIAN INSTITUTE OF SCIENCE, BANGALORE.

The largest number of research schemes financed by the Council of Scientific and Industrial Research in any single institute are in operation at this institute. The total number of schemes placed at the institute is 43 out of which 15 have been successfully completed. Investigations on Council of Scientific and Industrial Research schemes are being carried out in all the major departments of the Institute, viz., General Chemistry, Biochemistry and Fermentation Technology.

Industrial processes for the manufacture of phosphatic fertilisers and phosphorus from phosphatic nodules, the production of carbon-disulphide, rubber lined equipment for chemical industries, graphite lubricants from Indian graphite, potassium chlorate, hydrogen peroxide, etc., have been worked in the Institute up to the semi-commercial scale and are ripe for commercial exploitation. Organo-arsenical compounds, synthetic adrenaline, novocaine, aromatic chemicals, phenol, and sulphur compounds from coal, have been prepared on a laboratory scale and nitrobenzene, aniline, dimethyl aniline on a larger scale, in the department of Organic Chemistry. Large scale production of vegetable milks, disinfectants from indigenous essential oils, industrial enzymes like diastase, have been studied in the departments of Biochemistry and Fermentation Technology.

The enquiry on vegetable milks is deserving of special attention, embracing as it does a study of the biological value of the soya bean protein, the vitamin B complex, calcium fortification, availability of carotene and ascorbic acid and other important factors involved. The various steps involved in the processing to improve digestibility and the biological value of soya bean for production of milk have been standardised and a final process which yields a milk possessing about 90% of the overall food supplementary value of diary cow's milk has been evolved. 12 lakh pounds of the milk and curd have been produced and utilised in nutrition experiments on animals and children of different ages and vocations.

A great deal of attention has also been paid to the possibility of producing nutritively balanced milk from other vegetable products such as groundnut, cocoanut, cashewnut and cotton seed. Of these cashewnut yields a fairly well balanced milk possessing about 80% the nutrition value of cow's milk. The cost of this is, however, high as also is the cost of the milk from cocoanut. Work on the possibility of combining soya bean with groundnut and suitably balancing the resulting milk is in progress. This will enable utilisation of large supplies of indigenous groundnuts, without being dependent on soya bean which is in short supply, exclusively.

By digesting, under favourable conditions, groundnut cake, which is naturally rich in B vitamins, and concentrating the liquid obtained, a product rich in vitamin B can be obtained. Other seed cakes also yield similar products. The stability and preservation of their nutritive values is under investigation. The need for supplementing these preparations by addition of calcium and certain essential amino acids has been demonstrated by animal nutrition experiments.

Pilot plant experiments, which will have far reaching applications when completed, are in hand for treating food grains so as to kill the infesting insects and their eggs. The treatment is heating the food grain to approx. 120°C for a very short interval. A continuous treatment plant has been devised and the conditions of working are being standardised.

Successful efforts have been made in increasing the concentration of alcohol in distillery washes from the previous average of 7% to 16 to 18%. *Cytogenetics* of yeasts and fungi have been studied with a view to produce more potent strains of these cultures. A national collection of type cultures, which supplies the cultures for fermentations to all bonafide workers, is being maintained at the Institute since 1940.

During recent years vanaspati has attained a special importance in Indian dietaries, due to the shortage of pure butter fat. Work is being done at the institute to find out the effect of feeding vanaspati to human beings and animals kept mostly on cereal diet without adequate supplement of proteins, vitamins and minerals. These investigations are likely to bring out very interesting results.

In the field of medical practice antibiotic drugs of penicillin and streptomycin type are finding an increasing use in the treatments of varied types of ailments. Pilot plant studies on the production of penicillin were carried out in the department of Biochemistry sometime ago. Experiments have also been carried out to produce streptomycin from indigenous sources. Further work on both these products is still in progress at the Institute.

Among other schemes being worked in the Institute are (i) on the utilisation of industrial wastes as supplemental sources of nitrogen for the production of enzymes and vitamins, and (ii) on the treatment of industrial wastes with particular reference to textile trade wastes.

The subject of disposal and utilisation of industrial wastes is one which has not received the important attention that it deserves. The investigation on the treatment of industrial waste water in the textile industry is one of the few pioneer investigations in the field and important results have been obtained from field experiments at Ahmedabad after the initial laboratory tests at Bangalore. By running the waste water from the textile mills over a bed of gypsum alone, it is possible to mix the effluent with domestic sewage. The resulting mixture has been successfully utilised for growing crops on the Municipal Sewage Farm. In addition to bumper crops of

fodder very striking results have been obtained with sugar cane, a yield of 85 tons per acre being possible in some of the experimental areas.

UNIVERSITY OF CALCUTTA

Following Bangalore an important centre where Council of Scientific and Industrial Research schemes are being worked is the University of Calcutta. Here 28 schemes, of which 13 have been completed have been undertaken. The departments of Applied Physics, and Applied Chemistry of the University College of Science have been the chief recipients of these grants.

Work has been done at this university on the production of plastics from vegetable oils, high pressure splitting of oils, extraction of ionone from lemon grass, utilisation of commercial xylene for Dettol type of disinfectants, production of atropine, emetine, enterovioform, mono- and dialkyl anilines, alpha-naphthalene, extraction of potash salts from molasses etc. Work is at present in hand on the industrial production of butyl alcohol, acetone and organic acids generally from molasses by fermentation and on the low temperature carbonisation of Indian coals.

The radium content of Indian minerals and mineral springs has been determined, and methods for the testing of optical glass developed. Investigations pertaining to the field of radio research carried out at this university include the design and construction of loud speakers and carbon-microphones (both of which are ready for being passed on to industry), studies of the ionosphere (which is undertaken as part of an international programme), study of properties of insulating material of indigenous manufacture at high frequencies and the design and construction of radio valves. The scheme on the measurement of geological time in India had to be discontinued for want of a mass spectrometer, otherwise a large number of problems could have been investigated. Among the schemes of industrial importance at present being worked are the manufacture of vacuum pumps and air-conditioning machinery, the development of air-driven centrifuges and moving iron ammeter and voltmeters. Fundamental investigations are being carried out on Cosmic Rays, Raman Spectra and Luminescence spectra of organic compounds at low temperatures, micro waves emitted from extra-terrestrial sources, study of the upper atmosphere, nuclear physics and biophysics.

Monazite sands of Travancore are a valuable source of atomic minerals in the country. In keeping with the advance of atomic research

in the world, work is being carried out in the University on the extraction of rare atomic minerals (rare earths) from these sands. A systematic study of the chemical composition of the Tipper's collection of rare-earth minerals of India is also being carried out.

Besides the University of Calcutta some other research laboratories in Calcutta are also working on research schemes financed by the Council.

(a) *Bose Research Institute.* At this Institute work has been done on the cutting and testing of quartz crystals. The three schemes at present being worked are on the setting up of a powerful ultra-sonic generator, setting up of a medium voltage positive ray discharge tube for the investigation of nuclear disintegration and on trans-uranic elements.

(b) *Indian Association for the Cultivation of Science.* Under the auspices of the Council, work is being done on three schemes on the X-ray studies of coal, metals and alloys, and on the formation of vortices both theoretical and experimental, under conditions obtaining in the solar atmosphere. On the last two schemes, work has only recently been started.

(c) *Biochemical Standardisation Laboratory.* This laboratory is compiling a brochure on "Indigenous Drugs of India." When ready this would be a very useful treatise for workers in medical research. Another scheme being worked is on the pharmacological testing of optically active and racemic forms of compounds.

(d) *Presidency College.* The Physics department of this college is undertaking two research schemes of the Council on the study of polar crystals dissolved in glass systems and on the production of mesons with the help of the Wilson Cloud Chamber.

(e) *Indian Museum and Botanical Gardens.* The Indian Museum of Calcutta has also two research schemes on Jasmines of India and production of crude resin from *pinus excelsa*, under a grant from the Council. A scheme on rose cultivation is being investigated at the Botanical Gardens, Calcutta.

(f) *Other Institutes.* The Council has financed a scheme on the production of 8- amino-quinolines as a possible antimalarial at the Bengal Immunity Research Laboratories, another on the manufacture of graphite crucibles at 'Salkia' Howrah, and two schemes on the manufacture of X-ray transformers and on the manufacture of permanent magnets for

electrical instruments under Mr. B.B. Bhowmik, 'Radon House' Calcutta. A scheme on leather research is being worked in the Bengal Tanning Institute.

UNIVERSITY OF BOMBAY

The University of Bombay have developed a school of dye-stuff chemistry. The Council of Scientific and Industrial Research has had a good hand in the development of this school, by helping with a recurring grant for the creation of a Readership of Dye-stuff Chemistry in the department of Chemical Technology and instituting some research schemes on manufacture of various types of dyes. The schemes being worked in this department relate to the production of vegetable dyes, vat dyes, commercial dyes, and synthetic dyes and the analysis of coal tar products.

At the Royal Institute of Science, the Council has financed schemes on the manufacture of photographic plates, high purity salt and gelatin, and on the spectroscopy of fuels and their combustion. The first of these schemes i.e. on the manufacture of photographic material has been successfully completed and the results are being studied for commercial use. The scheme on the manufacture of high purity salt is of particular interest as the salt so produced is intended to be utilised in the alkali industry. The authors have been able to produce salt of 99.3% purity and the economics of the process are being examined.

UNIVERSITY OF MADRAS

Investigations were carried out on the production of dyes and dye intermediates, photographic developers, drugs and D.D.T. etc. Some of processes have been worked on a semi-commercial scale.

It was found that electrolytic reduction of nitro compounds in certain solvents was inadvisable on a commercial scale. Reduction of nitrobenzene in alkaline emulsion was, however, successful and very good yields of benzidine and hydrazobenzene were obtained. This is awaiting large scale production having passed the pilot plant scale. Other electrolytic processes producing dianisidine, dichloro dianisidine, ortho dichloro benzidine, 2, 2', 5, 5' tetrachloro-benzidine and the photographic developer 2, 4 diamino-phenol have been successfully worked. The production of toluidine and nitration of phenol have been investigated. The result was not as satisfactory as with benzidine. The methyl group retards the formation of hydrazotoluene, leading to the simultaneous formation of toluidine. Anticatalysts are being studied with a view to improve the yield.

Methyl sulphate was made economically on semi-commercial scale in the laboratories and used in methylation in place of methyl chloride for producing ortho-nitroanisole. The preparation of ortho-nitroanisole by an alternative method by chlorinating benzene etc., was developed to semi-commercial scale. Para-amino phenol has been prepared more economically than hitherto reported. Nitro-chloro-benzene was converted into nitro-anisoles and nitro-phenetoles and lead peroxide and cuprous oxide were used for the first time as catalysts.

Large scale production of D.D.T. was studied. Cheaper method for the drug phenacetin was worked out on semi-commercial scale. Preparation of ekinogen and para-hydroxy phenyl glycine was undertaken. Some of the chemicals like p-nitro chloro benzene, p-amino phenol and benzidine were prepared and supplied to various laboratories when there was a dearth of these chemicals.

Desiccated thyroid siccum was prepared from thyroids of Indian animals and found richer in iodine content than imported stuff. Para thyroxine was produced and its preservation, isolation and assay were studied. The method for isolation of adrenaline under Indian conditions was standardised. Using methods for the chemical preservation of adrenal, thyroid and pituitary glands discovered in the laboratories, the pituitary glands of cattle slaughtered in Bangalore were taken to Madras and processed for posterior pituitary powder. It was found that steaming of extract ampoules for 145 minutes was better than autoclaving at 115°C as recommended in British Pharmacopœa. Pituitrin was made economically and about 60,000 ampoules of it were supplied to the Government of India.

Research Committees

The researches at the laboratories of the Council are initiated with the approval of the Director, Scientific and Industrial Research, to whom proposals may come either from Assistant Directors or from other government departments including the defence organisations that played an important part in this respect during recent years and frequently referred certain specific problems for solution. Within specified limits, the expenditure for such research can be sanctioned by the Director, Scientific and Industrial Research, in exercise of powers delegated to him. All major schemes, however, exceeding these limits, are placed before the Board of Scientific and Industrial Research after a reference to relevant Research Committees, and the recommendations of the Board are sent to the Govern-

ing Body of the Council for necessary sanction. In urgent cases the sanction is given by the President on the recommendation of the Director, Scientific and Industrial Research and subsequently ratified by the Governing Body.

The investigations at different research institutes and universities, at the instance of the Council and financed by the latter cover an impressive variety of problems that have an important bearing on the industrial developments in the country. The proposals for these investigations emanate from members of the scientific staff of universities and research institutes and are referred in the first instance, along with important schemes submitted by the Directors and Assistant Directors of the Council's laboratories at Delhi to the Research Committees concerned. The Research Committees scrutinise them in the light of the capability of the investigator and facilities available at the place where the research scheme has to be worked. In doing so the proposals are considered as integral parts of a general plan for progressive development having due regard to considerations of priority and importance in the context of the prevailing conditions and problems of the country. Guided by such considerations the Research Committees sometimes give directions for conducting the investigations on suitably modified lines and on identical grounds they recommend total rejection of some of the schemes also. The decisions of the Research Committees go to the Board of Scientific and Industrial Research which frames specific recommendations thereon for consideration of and sanction by the Governing Body. The perspective of the various Research Committees that have led them to initiate specific investigations of importance in their respective scope and the results so far achieved are indicated in the following pages which also furnish the details of the constitution and personnel of such committees.

The grants sanctioned by the Council for these investigations cover, as a rule, the expenditure on equipment, staff and contingencies. Till their completion the investigators have to submit half yearly progress reports to the Director, Scientific and Industrial Research.

It is important to note in this connection that the research activities of the Council pertain not only to initiating and sanctioning the expenditure involved in specific investigations but also to assisting in the strengthening and development of particular universities and institutes with a view to provide the necessary organisation for specialised research and allied training in certain fields of admitted importance and potentiality. With

this object in view, the Council has been making a substantial grant to the Bombay University towards the maintenance of its newly organised department of Dye-Stuff Technology. Other recipients of similar grants are the Indian Statistical Institute, Calcutta for a scheme of training statisticians (covering both capital and recurring expenditure)—this is to give an impetus to the introduction of statistical methods in industrial production and scientific research; and the Indian Institute of Science, Bangalore, for the creation of a chair of Applied Mechanics for studying the problems relating to the manufacture of internal combustion engines. Recently the Council has sanctioned a capital grant of Rs. 75,000 to the Tata Institute of Fundamental Research for cosmic ray research and also a substantial amount for the development of building research at the Thomason Engineering College, Roorke. An annual contribution of Rs. 60,000 towards the maintenance of the Institute of Leather Technology organised by the Madras University has also been approved.

Vegetable Oils Committee

Date of constitution : August 1940

Personnel :

Mr. P. A. Narielwala	Chairman
Prof. V. Subrahmanyam	Member
Dr. S. A. Saletore	"
Dr. M. Qureshi	"
Dr. M. N. Goswami	"
Mr. Rajbans Bahadur	"
Sir J. C. Ghosh	"
Dr. S. Krishna	"
Dr. Karimullah	"
Dr. D. Y. Athawale	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>

PROBLEMS BEFORE THE COMMITTEE :

1. Extraction and Utilisation of Milk from Vegetable Oil Seeds (V. Subrahmanyam, Bangalore)
2. Preparation of Pre-digested and Concentrated Food Products from Edible Seed Cakes. (V. Subrahmanyam, Bangalore)

PROBLEMS COMPLETED AND THEIR UTILISATION :

1. *Antigas Varnish and Antigas Cloth.* (S. S. Bhatnagar and others, Calcutta).

The urgent need for perfecting a formula for the manufacture of antigas varnish from indigenous material was realised at a very early stage of the war and a special inter-departmental committee headed by Sir S.S. Bhatnagar as Chairman and Dr. J. S. Anderson, Messrs. E. O. Tattersall, E.J. Millar, S. S. Done and Lt. S. Hopwood with Mr. R. Stansout as Secretary was formed to supervise the progress of investigations. Huge quantities of antigas varnish were prepared from the formula evolved from Indian oils and other indigenous raw materials and millions of yards of antigas cloth were produced under the auspices of the Supply Department to meet urgent war time demands. The great importance attached to this work will be appreciated when it will be known that more than 8.2 million yards or over 73.8 million square feet of antigas fabrics were produced from the Council's formula upto December 1944, to supply the defence requirements of India and other Empire countries.

2. Use of Vegetable Oils as Lubricants (S. S. Bhatnagar and others, Lahore, Calcutta and Delhi)

A systematic study of various vegetable oils in order to use them as lubricants and improve their properties, was conducted by Sir S. S. Bhatnagar at Lahore before he joined the Government of India as Director, Scientific and Industrial Research. This investigation was continued at D.S.I.R.'s laboratories at Calcutta and Delhi in collaboration with the Railway Board and the oil companies. A special study of blown rapeseed oil and its mixtures with axle oils for use as axle lubricants in Indian railways was made and the compound oils discovered have been adopted by several railways. Huge quantities of these blended oils, valued at several crores of rupees, were manufactured using the formulae evolved under the joint auspices of the Council of Scientific and Industrial Research and the oil companies.

3. Special Oil for Copper—Bronze Axle Bearings. (S.S. Bhatnagar and others, Lahore and Calcutta).

As a result of this investigation a special oil was prepared from rapeseed oil, sulphur and axle oil and was adopted by the North Western Railway.

4. Dehydration of Castor Oil. (S. S. Bhatnagar and others, Delhi)

Conditions for large scale manufacture of dehydrated castor oil to ensure its efficiently replacing tung oil (china wood oil) in acute short

supply during the war, were studied and production of this oil has now been established as a regular industry in the country.

5. Splitting of Oils by Sulphonic Acid Catalysts and also by Enzymes (M. N. Goswami and others, Benaras).

As a result of this work, processes for the manufacture of stearic and oleic acids have been developed and are under utilisation by the Calcutta Chemical Co Ltd., Calcutta.

6. Sulphonation of Indian Vegetable Oils. (K. G. Naik and others, Baroda).

Various sulphonated products which are useful as wetting agents in dyeing, scouring, and finishing of textile material, have been evolved by Dr. Naik. These products have been found to be superior to many wetting agents imported from abroad. Castor oil, coconut oil, rapeseed oil, pine oil, mustard oil, sesame oil are some of the Indian vegetable oils which have been investigated from the standpoint of the suitability of the sulphonation products obtained from them. The question of utilising these results is under examination.

7. Denaturants from Neem Oil Cake. (Godbole, Benaras.)

The denaturant developed by Prof. Godbole has been found satisfactory both as regards its effectiveness and toxicity and is a good substitute for pyridine and caoutchoucine (the denaturants usually used) which were in short supply during the war. It is now intended to examine other nonedible seed cakes for a similar purpose.

8. Splitting and Polymerisation of Vegetable Oils and Particularly Castor Oil. (Qureshi and others, Hyderabad-Deccan).

This investigation has yielded interesting results and a number of products useful for the manufacture of drying oils, plastics, insecticides etc., have been prepared by splitting castor oil at high temperatures. The laboratory investigations have been completed and the development of results is being considered.

SURVEY FOR FUTURE PROBLEMS AND OTHER ACTIVITIES :

1. *Solvent Extraction of Oils.* Dr. Athawale has been requested to prepare a pamphlet on continuous solvent extraction process for the information of the public. The pamphlet will be published by the Council.

2. *Isomerisation and Dimerisation of Fatty Acids, Manufacture of Plasticisers, Higher Fatty Aldehydes and Alcohols.* Dr. J. S. Aggarwal has prepared a review of the literature and has submitted detailed proposals on the lines on which research work should be carried out in India. The matter is under consideration by the Committee.

3. *Studies in Glycerides.* Drs. Subrahmanyam, Athawale, Karimullah and Puntambekar were requested to jointly prepare a programme bearing on the chemical and biological aspects of various glycerides, including forest oil seeds, in consultation with experts of various institutions where research work is proposed to be conducted.

4. *Rancidity.* Dr. Athawale and Bannerji have been requested to prepare a note on the information already available on the subject and the scope for further research.

5. *Stability of Fats in Baked Products.* Dr. Siddiqui has been requested to prepare detailed programme of research on the stability of fats in baked products like biscuits, cakes, sweetmeats etc. The investigation will be conducted in the Council's laboratories.

6. *Wetting Agents.* Sir S. S. Bhatnagar has been requested to prepare a note in consultation with Dr. K. Venkataraman on the scope for research work on this important subject in India.

7. *Proteins, Adhesives, Fibres etc.* Sir S. S. Bhatnagar has prepared a note on the subject indicating the programme of work and institutions where it is to be carried out. A scheme of work is to be placed before the Board at its next meeting.

8. *Stearic Acid.* Drs. Karimullah and Athawale have been requested to prepare a note on the scope of research on the hydrogenation of non-edible vegetable oils and animal and other fats with a view to rendering them suitable for stearic acid manufacture.

9. *Constitution of Indian Vegetable Oils.* Mr. P. Ramaswami Iyer of Bangalore has been requested to prepare a note on fundamental problems bearing on the constitution, properties etc. of Indian vegetable oils.

10. *Substitutes for Oil in Soap Industry.* In view of the acute shortage of cocoanut oil, the use of non-edible and other oils as substitutes for cocoanut oil is recommended to be investigated.

11. *Activated Carbons.* Dr. Athawale has been requested to prepare a pamphlet on the manufacture of activated carbons for publication by the Council.

OTHER MATTERS:--

On an important point, regarding a line of demarcation between the activities of the Vegetable Oil Committee and the Indian Oil Seeds Cess Committee, the Committee came to the following considered decision on the 17th June 1947:

“The Oilseeds Cess Committee should confine its activities to agricultural and botanical aspects of oilseeds upto the storage stage, while the scientific and technological research including utilisation and processing in the field of oilseeds, oil and related products should be carried out by the Vegetable Oils Research Committee. However, in borderline subjects, such as preservation of oilseeds, etc. in which scientific research is indicated, there should be close collaborative work by the two organizations. In order to define clearly the scope of work of the two organisations and also to draw up a common programme of research, the Committee decided to hold joint meetings with the Cess Committee as soon as possible”.

There can be no hesitation in stating that the Vegetable Oils Research Committee is one of the most successful of the Research Committees of the Board of Scientific and Industrial Research, both from the point of view of the success of its research schemes and its achievements. The value of the benefits which have accrued to the nation from the activities of this committee have run into crores of rupees worth of material.

Dyestuffs Committee.

Date of Constitution: July 1940.

Personnel:

Sir J. C. Ghosh	Chairman
Dr. K. Venkataraman	Member
Dr. B. B. Dey.	”
Dr. Bashir Ahmad	Secretary
Director, Scientific and Industrial Research.	<i>Ex-officio</i>

The Committee came into existence on the amalgamation of the Vegetable Dyes Committee and the Synthetic Dyestuffs Committee

SCHEMES UNDER INVESTIGATION :

1. Manufacture of Synthetic Dyes from Catechin, (K. Venkataraman, Bombay.)
2. Determination of the Constitution of Some Commercial Dyes (K. Venkataraman, Bombay.)
3. Preparation of Vat Dyes (K. Venkataraman, Bombay.)
4. Manufacture of Direct Cotton Colours (B. B. Dey, Madras.)
5. Manufacture of Sulphur Black from Benzene and Naphthalene (R. D. Desai and others, Bombay.)

SCHEMES COMPLETED:

1. Electrolytic Preparation of Benzidine (B. B. Dey and S.C. Rajagopalan, Madras.)
2. Electrolytic Preparation of *p*-amino Phenol (B.B. Dey and S. C. Rajagopalan, Madras.)

Using the coal tar primaries as the raw material and the electrolytic method of reduction a satisfactory method has been evolved for the production and purification of hydrazo benzene and *p*-amino phenol. Consistently reproducible results were obtained in respect of yield and current density. The processes have been patented. -

3. Nitration of Phenol—(B.B. Dey and others, Madras).

The optimum temperature conditions for securing the best yields of the ortho and para nitro phenols were found to be slightly different when potassium nitrate was used for nitration. In the presence of lead and lead salts, the ratio of para to ortho-nitrophenol increases considerably when the nitration is carried out at a temperature a little below 20°C. The results have been published in the Journal of Scientific and Industrial Research.

4. Preparation of O-Nitro Anisole (B.B. Dey and others, Madras).

In the methylation of ortho nitro phenol, the yields are influenced by a number of factors, specially the fineness and the molar ratio of Na_2CO_3 , dimethyl sulphate and temperature.

5. Nitration of Naphthalene (B.B. Dey and others, Madras).

Experiments on the nitration of Naphthalene were conducted to ascertain the optimum conditions for obtaining the maximum yield and purity of nitro naphthalene.

6. Reduction of Nitro Naphthalene (B.B. Dey and others, Madras).

A standard procedure for the electrolytic reduction of nitro-naphthalene in acid solution at a suitable cathode without the resultant product being contaminated by naphthols has been worked. The reduction of O-nitro-toluene to hydroazotoluene has also been studied. A number of improvements have been patented.

7. Large Scale Preparation of Nitro Benzene, Aniline and Dimethyl Aniline (P.C. Guha and others, Bangalore).

Pilot plant experiments for the large scale preparation of these intermediates have been completed and yields of 95% and over have been obtained.

8. Preparation of Vat Dyes (K. Venkataraman and collaborators, Bombay).

9. Preparation of Anthraquinone Vat Colours (K. Venkataraman and collaborators, Bombay).

10. Preparation of Sulphur Vat Colours (K. Venkataraman and collaborators, Bombay).

11. Preparation of Anthraquinine Vat Colours (K. Venkataraman and collaborators, Bombay).

The purity of the commercial vat dyes has been determined and processes for their manufacture have been developed.

Modifications in the method of preparing benzanthrone have been effected to make the process more economical with a view to carry out the reaction in a cast iron vessel. A number of patents have been taken out as a result of these investigations and they are awaiting exploitation.

12. Dye Extracts and Dye Shades on Wool and Cotton from the Bark of *Terminalia Arjuna* and *Butea Frondosa* (K. Venkataraman and others, Bombay).

Different shades of dyes have been obtained with different fixing agents. Direct boiling in non-metallic vessels was better than boiling with steam or in vacuum. Fresh bark yields better and more dye than old and dried bark. The process has been patented and leased to Howrah Trading Co., Ltd., Calcutta.

13. Dye Extracts and Dye Shades on Wool from Tamarind Seed Testa (K. Venkataraman and others, Bombay).

A dye extract from tamarind seed for wool dyeing was prepared by an improved extraction method. The process has been patented and leased to Howrah Trading Co., Ltd., Calcutta for exploitation.

14. Annato Dye Extracts (K. Venkataraman and others, Bombay).

A vegetable colouring matter for colouring vegetable ghee, milk, ice cream, aerated waters, and other food products has been developed and patented. The process has been leased out to Dairy Products and Manufacturing Co. Ltd., Amritsar for exploitation.

OTHER ACTIVITIES :

India has been dependent on foreign countries for dyestuffs ever since synthetic dyes came to hold their own and the use of the vegetable dyes, excepting a very few, was discontinued. The advantages of using synthetic dyes are many but during war time when these dyes were scarce and there was no synthetic dye industry in the country, one had to look to the vegetable dyes. The vegetable dyes committee set up by the Board of Scientific and Industrial Research submitted a comprehensive report and its main recommendations can be summarised in these words.

Instead of trying to substitute vegetable dyes for synthetic dyestuffs it would be more beneficial if the use of the former can be found in places where the latter cannot effectively compete, in which case even after the war, the vegetable dyes can hold their own. Such fields of use are, for example, the colouring of cheese, confectionary, hair oils, face powders, foods, drinks and cosmetics. "The vegetable dyes committee attempted to discover suitable and rich sources and to work out methods of extraction in standardised form.

The dyestuffs committee considered all the information gathered on the consumption of various kinds of dyes in India, the raw material and other chemicals available in the country and other aspects of dyestuff

industry. The committee came to the conclusion that the case for the establishment of a dyestuff industry must be accepted in view of its relation to the premier textile industry and other branches of chemical industry; the establishment of a dyestuff industry is a vital factor in national security and self sufficiency and therefore steps must be taken as early as possible to examine plant requirements and import possibilities; that a technical chemist with an adequate knowledge of dyes be deputed to U.S.A., to make detailed enquiries and submit a report.

The Dyestuffs Exploratory Committee submitted a comprehensive report dealing with the following aspects :—

- A. History of the dyestuffs industry.
- B. Value and importance of the dyestuffs industry in the economy of a country.
- C. Survey of the consumption of dyes in India.
- D. A plan for the Indian dyestuffs industry.
- E. Raw material for the manufacture of dyestuffs in India.
- F. Plant and equipment for the dyestuffs industry.
- G. Location of the dyestuffs industry.
- H. Organisation of the dyestuffs industry.
- I. Organisation of the feeder industries.
- J. Internal organisation of the dyestuffs industry.
- K. Recommendations.

The important recommendations are summarized below :—

- (i) In view of its importance in national economy a dyestuff industry should be established in India as early as possible.
- (ii) The plan for an Indian dyestuffs industry should comprise.
 - (a) manufacture of an extensive list of 51 dyes within a period of 5 years after a brief period of preparation of incubation.
 - (b) manufacture of some of the intermediates during this incubation period of 5 years.
 - (c) production of all intermediates required for the 51 dyestuffs within 10 years.
 - (d) production of all the dyes in substantial demand including the necessary intermediates within 15-20 years.

(iii) To ensure adequate and cheap supply of sulphuric acid, one of the five important heavy chemicals needed in the industry, production of the acid from gypsum should be ensured.

(iv) Arrangements for the manufacture of other heavy chemicals at a reasonable price in sufficient quantity should be made.

(v) To meet the demand for the supply of nitrogen fertilisers, synthetic ammonia, nitric acid and other similar articles, a nitrogen fixation industry should be established as a national enterprise.

(vi) Production of synthetic methanol and its conversion to formaldehyde should be established in view of its importance to chemical industries in general and the plastic industry in particular.

(vii) Manufacture of synthetic acids and their derivatives should be undertaken on a large scale.

(viii) Arrangements to fabricate or procure the equipment needed for the dyestuffs industry should be ensured.

(ix) An expert committee should decide on the location of the dyestuffs industry after survey of the sites.

(x) Cooperation for technical assistance and expert advice with foreign firms should be arranged.

(xi) The manufacture of intermediates and dyestuffs should be carried out in one central factory which should undertake to produce all the stages of dyestuff manufacture from coal tar raw material.

(xii) Grants for training of technologists and research in intermediates and dyestuffs should be made to the National Chemical Laboratory and the National Physical Laboratory.

(xiii) A survey of inorganic chemicals, coal tar distillation products and aliphatic chemicals to explore their consumption and production should be undertaken.

Steps to implement these recommendations are being taken. Endeavours to obtain the services of German specialists and technicians are being made.

Industrial Fermentation and Biological Products Committee

Date of Constitution : July 1940.

Personnel :

Dr. M. Damodaran	Chairman
Dr. B. C. Guha	Member
Dr. Bashir Ahmad	"
Dr. K. N. Bahl	"
Dr. H. D. Sen	"
Dr. Habib Hassan	"
Mr. M. Sreenivasayya	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>

The Committee was originally constituted under the name "Molasses Committee" with the express directive to find ways and means of utilising surplus molasses from the sugar industry. The field under the committee was later widened to cover all industrial fermentations and related biological products and its name changed to the I.F. & B.P.C.

PROBLEMS BEFORE THE COMMITTEE :

The following schemes are at present being worked under the auspices of the Committee :—

1. Fermentative Production of Acetone, Butanol, Solvents Generally, and Acids from Molasses (B. C. Guha and B. N. Ghosh, Calcutta).
2. National Collection of Type Cultures (M. Sreenivasaya, Bangalore).
3. Production of Industrial Enzymes (M. Sreenivasaya, Bangalore)—(in abeyance).
4. Increasing Alcohol Concentration of Fermented Distillery Washes. (M. Sreenivasaya, Bangalore).
5. Cytogenetics of Yeasts and Fungi (M. Sreenivasaya, Bangalore).
6. Production of Potent Strains of Yeast (Bashir Ahmad).
7. Proteins and Proteases with Special Reference to Industrial Applications (M. Damodaran, Madras).

8. Carbohydrate Metabolism of Fungi with Particular Reference to Citric and Oxalic Acid Fermentations (M. Damodaran, Madras).
9. Manufacture of Sorbose from Sorbitol (M. Damodaran, Madras).
10. Production of Glucose from Cheap Starchy Tubers (M.O. Farooq and M. A. Aziz).

Of particular interest to industrial fermentation industries and research in India is the National Collection of Type Cultures, at present being maintained by the Council at the Indian Institute of Science, Bangalore. In this collection over 500 pure type cultures of fermentative micro-organisms are being maintained, properly classified and scientifically cared for. A lyophilization unit is being added to the equipment of this collection. This will obviate the need for constant renewal of the type cultures. Since its inception supplies of type cultures have been made to various research laboratories all over India and also to a number of industrial concerns.

In the scheme for the production of potent strains of yeast. (No. 6 above), a pilot plant has been fabricated for the manufacture of good yeast from molasses. This pilot plant has not been worked so far, on account of the lack of space in the Delhi laboratories of the Council of Scientific and Industrial Research. Negotiations were made to lease out this plant to Messrs. Amritsar Distilleries but due to the turbulent conditions in the Punjab these could not be finalised. The Board of Scientific and Industrial Research have approved postponement of the working of the plant till the laboratories shift to Poona in the National Chemical Laboratory buildings.

Using a specially treated strain of a culture of yeast (*Sacharomyces Cerevisac*), which is acclimatized to function in high concentrations of both molasses and alcohol, it has been found possible to increase the concentration of alcohol in the fermented distillary washes from an average of 7% by volume to 16% by volume. This increase has been confirmed by actual large scale experiments.

SCHEMES COMPLETED AND THEIR UTILISATION.

The following schemes worked under the auspices of this committee have been successfully completed and their details have been passed on to industry for exploitation of the results :—

1. Recovering Potassium Salts from Molasses—(P. Ray and B. K. Mukerji, Calcutta).

Under this scheme a method for recovering the valuable potassium salts such as potassium carbonate, potassium sulphate, and potassium chloride from burnt molasses has been worked out. This process has been leased out to Messrs. Khaitan & Sons, Calcutta, and Messrs. Ganesh Sugar Mills Ltd., Anandnagar for commercial exploitation.

2. Production of Gluconic Acid from Molasses. (J. N. Ray, Lahore and B. C. Guba, Calcutta.)

A method for the manufacture of calcium gluconate has been successfully developed. It has been entrusted to Messrs. Gluconate Ltd., Calcutta for industrial production.

SCHEMES SANCTIONED BUT NOT WORKED.

The following schemes of research were sanctioned by the Board of Scientific and Industrial Research on the recommendations of the Committee, but they have not been worked so far, for reasons given against each.

1. Large Scale Production of Baker's Yeast. (The Punjab Agriculture College, Lyallpur).

This scheme was sanctioned in 1945-46 but has not been worked since the investigators lost interest in the working of the scheme.

2. Utilisation of Industrial Wastes as a Supplemental Source of Nitrogen and Vitamins for Industrial Fermentations. (M. Sreenivasaya, Bangalore).

The scheme is being held in abeyance at the request of Mr. Sreenivasaya, who has gone out of the country during this year. It is likely to be taken up next year.

3. Production of Pure Amino Acids by Fermentation (Mansa Ram, Delhi University).

Mr. Mansa Ram was unable to undertake the scheme since he had severed his connections with the Delhi University.

OTHER ACTIVITIES OF THE COMMITTEE.

1. 'Survey'. Under the auspices of the Committee a preliminary countrywide survey of fermentation industries, their raw material and possibilities of expansion is being carried out. When the report of this survey has been considered by the Committee, recommendations will be

made to the Government for the development of the industry on scientific and economic lines.

2. "*List of Type Cultures*". A consolidated list of the various type cultures of scientific, medical and industrial importance is being prepared by the Committee. This will be a very useful guide to workers on any type of fermentation in India.

3. *Plan of Research in Fermentation*. The Committee have, after careful thought, indicated a plan of research in the field of fermentation to meet the needs of the country.

4. *Institute of Fermentation Technology*. The Committee recommended to the Board of Scientific and Industrial Research that a Central Institute of Fermentation Technology, be established in India at an early date pending which a section of fermentation technology may be started in the National Chemical Laboratory, Poona. This recommendation was accepted and such a section is being provided for in the plans of the National Chemical Laboratory.

Drugs & Pharmaceuticals Committee.

Date of Constitution : July 1940.

Personnel :

Dr. Jivraj N. Mehta	Chairman.
Sir R.N. Chopra	Member
Dr. J. N. Ray	"
Dr. P. C. Guha	"
Dr. B. Mukerji	"
Dr. S. Sen	"
Dr. H. Ghosh	"
Dr. B. B. Dikshit	"
Dr. S. Siddiqui	"
Dr. K. A. Hamied	"
Col. S. S. Bhatnagar	"
Director, Scientific and Industrial Research.	<i>Ex-officio.</i>

PROBLEMS BEFORE THE COMMITTEE.

1. Production of Penicillin and Other Antibiotics (V. Subrahmanyam, Bangalore.)
2. Preparation of Glandular Products and Commercial Utilisation of Shark Wastes. (B. B. Dey, Madras).

3. Chemical and Pharmacological Effects of Optically Active Substances and their Racemic Forms. (B. K. Singh and B. Mukerji).
4. Study of Active Principles of Saha Farsee (M.O. Farooq, Aligarh).
5. Study of Active Principles of Bemisal Bel (M. A. Aziz, Aligarh).
6. Study of the Active Principles of Kakra Singhi, Brahmi and Brahmi Manduki. (Karimullah, Delhi).
7. Production of Pyrethrum and Pyrethrum Substitutes (S. Siddiqui, Delhi).
8. Production of Polyhydric Alcohols from Sugars (Karimullah, Delhi).
9. Drugs (S. Siddiqui, Delhi).
10. Investigations on Neem (S. Siddiqui, Delhi).
11. Antimalarials and Antidysentrics from Indigenous Sources (S. Siddiqui, Delhi).
12. Compilation of Book on Indigenous Drugs of India (S. Siddiqui, Delhi and B. Mukerji, Calcutta).
13. Studies on the Chemistry of Penicillin (V. Subrahmanyam).
14. Active Principles of Karaff Seeds (M.O. Farooq and Kiamud Din).
15. Preparation of Synthetic Adrenaline (P. C. Guha).

The following schemes have recently been recommended for sanction:-

1. Study of 8-aminoquinoline Derivatives as possible Antimalarials (U. P. Basu, Calcutta).
2. New Antimalarials (P. C. Guha, Bangalore).
3. Survey, Cultivation and Improvement of Medicinal Plants (R. N. Chopra, Srinagar).
4. Establishment of an "Antibiotic Research Centre" (Col. S. S. Bhatnagar, Bombay).

The Committee has concerned itself solely with research in the field of new and potent drugs or for finding substitutes for drugs normally in short supply. Amongst the important researches now being undertaken is the one on penicillin and other antibiotics. Experiments are being conducted to make the uses and clinical applications of penicillin more versatile and efficient. The chemistry of penicillin is also being studied. Among the glandular products being studied are the hormones from the posterior pituitary extract, cortical extract and insulin. Work is also in progress on the products from anterior pituitary. Adrenaline, pituitrin, thyroxine and thyroid have been prepared on a semi-commercial scale and the process

of their manufacture has been fully worked out. Actual production has been undertaken in the laboratories of the Presidency College, Madras, to meet the urgent war-time requirements of government medical departments.

Compilation of a comprehensive brochure on drugs indigenous to India and giving their medicinal action etc. covering the work done in this field during the last 25 years, has been entrusted by the committee to Dr. S. Siddiqui and Dr. B. Mukerji. It is expected that this brochure will be ready shortly and when published, will form a handy and useful guide to the medical and pharmaceutical professions.

SCHEMES COMPLETED AND THEIR UTILISATION.

1. Preparation of Enterovioform (P. C. Mitter, Calcutta).

Under this scheme an improved method for the preparation of Enterovioform has been worked out. The process has been released to all interested parties as technical advice free of charge.

2. Manufacture of Organo-Arsenical Compounds (P. C. Guha, Bangalore).

A process has been evolved for the preparation of several organo-arsenical compounds such as sulph-arsenamides, neo-arsphenamides, stovarsol, atoxyl and carbarsones. The last two of these have been passed on to Messrs Zandu Pharmaceutical Works Ltd., Bombay.

3. Examination of the Active Principles of the Chandni Roots (R. H. Siddiqui, Aligarh).

The total bases of chandni roots have been isolated. Of these one particular base has been isolated in a pure form and its pharmacological action on the pupil of the eye has been studied.

4. Preparation of Dettol Type of Disinfectants. (P. C. Mitter Calcutta.)

p-chloro-m-xyleneol has been found to be the active constituent of "Dettol" type of disinfectants. This chloro-hexanol has been prepared from coal tar acids produced in India. The whole-process of preparing the disinfectant using chloroxylenol, soap, essential oils and alcohol has been worked out. This process has been leased out to Messrs. The Bengal Chemical and Pharmaceutical Works Ltd., Calcutta for development.

5. Production of Atropine, Emetine, and Apomorphine (P.C. Mitter, Calcutta).

Following the standard methods and using fusel oil and petroleum ether in place of costly and often unobtainable solvents, atropine has been prepared from belladonna, emetine from ipecacuanha and apomorphine from morphine.

6. Production of Marmite and Beemax-like Products (B. Ahmad, Lahore).

Processes for the manufacture of yeast concentrates and of products like Marmite and Beemax, which are rich in vitamin B, have been developed. A pilot plant for the production of about 2 lbs. of yeast a day has been set up. Utilisation of the process is in hand.

7. Investigations on Steroids. (M. C. Nath, Nagpur).

Investigations have been conducted on the preparation and biochemical examination of the sex-hormone androsterone from the milky latex of the Indian jack fruit *Atrocarpus Integrifolia*. The vitamin D activity of new steroids obtained from cholesterol has also been investigated.

8. Other Schemes Completed.

Processes have been worked out for the synthesis of yatren and phenacetin from phenol. Novocaine has been synthesised from easily available raw materials.

OTHER ACTIVITIES OF THE COMMITTEE.

1. *Programme of Drug Research.* The Committee have drawn up a programme for planned research in the field of drugs and pharmaceuticals. Besides the active principles of ergot, it covers work on indigenous drugs, syntheses of vitamins, hormones, and hormone like products, antimalarials of the type of atepirin, plasmoquin, cardiazol, coramine, euphyline, penicillin, etc. etc.

2. *Central Drug Research Institute for India.* The committee has drawn up a comprehensive plan for a Central Institute for Drug Research in India, where drug research could be promoted in general, from botanical, chemical, pharmaceutical, pharmacological, bacteriological, microbiological and clinical view-points. A section has been specifically provided for the testing and standardisation of the new drugs evolved in the Institute. The plan is now under the active consideration of Government.

In order to have a clear conception of the immediate needs as well as a long range plan of work, the committee decided that a survey of existing facilities in the way of trained personnel, equipment and laboratories in the whole of India and of research work done in the country on drugs should be carried out.

The Committee also considered the possibilities of producing atebirin in India and came to the conclusion that as the basic raw materials were not available, manufacture of the drug in the country would be uneconomical. They, however, recognised the necessity of research in other anti-malarial drugs which can be produced from indigenous sources.

Essential Oils Advisory Committee

Date of Constitution : July 1940

Personnel :

Mr. P.A. Narielwala	Chairman
Dr. S. Krishna	Member
Dr. P.C. Guha	"
Dr. S. Dutt	"
Dr. A.K. Menon	"
Mr. S.N. Bal	"
Mr. K.P. Biswas	"
Mr. J.N. Rakshit	"
Mr. B. Maitra	"
R.B. V.A. Tahmane	"
Mr. S.D. Kapoor	"
Director, Scientific and Industrial Research	<i>Ex-Officio</i>

PROBLEMS BEFORE THE COMMITTEE.

The following schemes are being worked under the Committee:—

1. Manufacture and Utilisation of Rosin (N.R. Dhar, Allahabad).
2. Rose Cultivation (K.P. Biswas, Calcutta).
3. Cultivation of Oscimum Plants in U. P., (Director of Agriculture, U. P., Dehra Dun).

4. Utilisation of Essential Oils as Disinfectants (V. Subrahmanyam, Bangalore).
5. Preparation of Aromatic Chemicals (P.C. Guha, Bangalore).
6. Jasmine in India (S.N. Bal, Calcutta).
7. Crude Resin from Pinus Excelsa (J.N. Rakshit, Calcutta).
8. Essential Oils from Bitter Oranges (B.K. Malviya, Lucknow).
9. Extraction of Oils from Juniper Berries and Costus Roots.
10. Investigations on Keura.
11. Manufacture of Coumarin.

Of the aromatic chemicals, musk oxylol, musk ambrette and musk ketone have been successfully prepared on the laboratory scale. Experiments on jasmine have been completed and a report is awaited.

A large number of nurseries were visited in connection with the scheme on 'Rose Cultivation' and numerous specimens were collected.

SCHEMES COMPLETED AND THEIR UTILISATION.

1. Economic Utilisation of Turpentine Oil for the Manufacture of Turpeneol (Desai and Joshi, Bombay).
2. Ionone from Lemon Grass Oil (M.N. Goswami and others).
3. Industrial Preparation of Lemon Grass Oil (M. N. Goswami and others, Calcutta).

By heating citral and acetone with different condensing agents under varying conditions of temperature and pressure and suitably treating the product obtained, ionone is formed. A maximum yield of 80% of beta ionone and 55% of alpha ionone has been obtained. Pilot plant experiments have been completed and the results await utilisation.

4. Cultivation of Patchouli in C.P. (Director of Industries, Nagpur).

Experiments on the cultivation of patchouli in C. P. and Behar were tried with 50 fresh and sound cuttings obtained from the Silviculturist, Bombay, but most of the cuttings died before germination.

5. Cultivation of Palma Rosa Grass (C.P. Shah, Poona).

Distillation of oil from rosa grass from the plantation on a small plot of land at Poona was conducted. While the yield per acre of grass is very good, essential oil content of the grass was found to be very low.

6. Sweet Orange and Lemon Oil (S. A. Saletore and D. C. Kane, Nagpur).

The limiting factor in the expression of oil from Orange Peel is the fermentation that sets in and which may be prevented by keeping the temperature of extraction water at 18°C. Two to three hours soaking in water followed by mincing in a mincing machine and squeezing the minced meal by hand is the simplest method of extraction, suitable for cottage industry. Yield of the oil is 1.4%; steam distillation of the residue yields a further 0.32% of the oil.

OTHER ACTIVITIES.

1. The following surveys have been conducted under the auspices of the Committee :

- (i) Survey of Aromatic Chemicals in India (S. Krishna, Dehra Dun).
- (ii) Survey of Aromatic Plants in India (S. Krishna, Dehra Dun).
- (iii) Survey of Raw Material for Essential Oils.
- (iv) Survey of Essential Oil bearing Plants of Bengal.

2. The possibility of manufacturing pine oil from pine needles is being investigated by Dr. Krishna.

3. Elucidation of the chemistry of indian rosin is under consideration by P.C. Guha.

4. A report on "Khus" has been completed and the Indian Council of Agricultural Research have been requested to take up the scheme. A monograph on the subject has been published.

Cellulose Research Committee.

Date of Constitution : July 1940.

Personnel :

Dr. S. Krishna	Chairman
Dr. L. Thoria	Member
Dr. J. K. Chowdhury	"
Prof. N. N. Godbole	"
Sir Shri Ram	"
Mr. M. P. Bhargava.	"
Director, Scientific and Industrial Research	<i>Ex-officio.</i>

PROBLEMS BEFORE THE COMMITTEE.

1. Survey of Cellulose Bearing Materials of India. (Nazir Ahmed and D. L. Sen, Bombay).

A detailed investigation in connection with cellulose bearing materials in India and the methods of recovering the cellulose is being carried out under this scheme. This investigation is of vital importance to several industries utilising cellulose, some like paper products already in existence in the country, others like artificial silk, plastics, explosives etc., which it is necessary to establish to make the country self-sufficient. The preliminary results obtained have already been published in the Journal of Scientific and Industrial Research. It is hoped that the technical data published as a result of this investigation would focus attention on promising materials and would lead to the development of industries in which these materials are employed.

2. Preparation of Alkali and Water Soluble Ethyl Cellulose. (C. S. Patel, Baroda).

OTHER ACTIVITIES:

1. Dr. Patel and Dr. Babbar have been asked to prepare detailed schemes on the following:—

- (a) Use of carboxy, methyl and ethyl cellulose in textile processing.
- (b) Study of differences in the properties of ethyl derivatives obtained from different sources.
- (c) Mixed fatty acid esters of cellulose.

2. Dr. Thoria has been asked to prepare a detailed scheme on pilot plant trials on standardisation of raw lintres and chlorination process of pulp making.

3. Suggestions have been made to the Forest Research Institute, Dehra Dun, to investigate the following problems:—

- (i) Mechanical pulp from certain varieties of timbers of Assam and Andamans and the chemical analysis of bamboo.
- (ii) Recovery of lignin and utilisation of it. (large scale trials).

(iii) Preparation of a research scheme on standardisation of cellulose materials and preparation of cellulose from hard woods by Dr. Bhargava.

(iv) Synthetic resin in the manufacture of various kinds of boards.

4. The recommendations made by Dr. Thoria on the location of a Rayon factory in India have been published.

5. Dr. Nabhar has been requested to prepare an article on 'action of paints, pigments, rubber etc. on cellulose material' for publication in the Journal of Scientific and Industrial Research.

6. Suggestions have been invited for the formulation of a scheme on the study of differences in cellulose obtained from various sources.

Heavy Chemicals and Chemical Industries Committee.

Date of Constitution : July 1940.

Personnel :

Dr. Mata Prasad	Chairman
Dr. M. Qureshi	Member
Mr. S.G. Sastry	"
Sir J.C. Ghosh	"
Director, Geological Survey of India.	"
Prof. J.N. Mukherjee	"
Mr. L. Gupta	"
Mr. G. C. Mitter	"
Dr. M.D. Parekh	"
Director, Scientific and Industries Research.	<i>Ex-officio</i>

This committee was enlarged in 1943 so as to include within its scope the functions of the following Committees :—

- (a) The Heavy Chemicals Committee.
- (b) The Naturally Occuring Salts Committee.
- (c) The Fertilisers Committee.
- (d) The Sulphur Committee.
- (e) Committee on Distillation and other Chemical plants.

PROBLEMS BEFORE THE COMMITTEE.

1. Manufacture of Carbon Disulphide from Charcoal and Sulphur. (N. N. Godbole, Benares).
2. Utilisation of the Bauxite Deposits of C.P. (S.A. Saletore).
3. Extraction of Sulphur Compounds from Coal (P. C. Guha, Bangalore).
4. Production of Phenol by Benzene Sulphonic Acid Process (P. C. Guha, Bangalore).
5. Electric Furnace Treatment of Coal Rich in Sulphur (Assam Coal) (J.C. Ghosh, Bangalore).
6. Manufacture of Phenol from Chlorobenzene (G.P. Kane).
7. Electrolytic Oxidation of Potassium Manganate to Permanganate (G.C. Mitter).
8. A Study of Industrial Catalysts in the following industries :—
 - (a) Manufacture of Industrial Hydrogen.
 - (b) Manufacture of Synthetic Ammonia at High Pressure.
 - (c) Fischer—Tropsch Reaction (J.C. Ghosh and others).

SCHEMES COMPLETED AND THEIR UTILISATION.

1. Manufacture of High Purity Salt (Mata Prasad, Bombay).

This was an attempt to produce salt of 99.2% sodium chloride content by solar evaporation with a view to its direct utilisation for the electrolytic manufacture of caustic soda and chlorine. By a process of fractional crystallisation on special hard bed crystallisers, loosening of the crystals by wooden rakes from time to time and washing and centrifuging, it has been possible to obtain common salt of the purity required and only containing less than 0.1% insolubles 0.2% calcium salts and 0.4% magnesium salts. The cost of this purified salt is estimated at Re. 1-0-3 per maund. The economics of the process and its development are under consideration.

2. Manufacture of Titanim Dioxide from Illmenite and Rutile.

Processes have been developed for the manufacture of titanim dioxide from illmenite and rutile. Titanium pigments of good tinctorial properties have been obtained. The process has reached the stage of industrial utilisation.

3. Manufacture of Sodium Sulphide from Sodium Sulphate.

Using water gas and perchloron, the process has yielded satisfactory results. A final report on the process is being prepared.

4. Manufacture of Ammonium Phosphate from Calcium Phosphate. (S.S. Bhatnagar, S. Parthasarthy and L.C. Kant, Delhi).

The underlying problem is the conversion of the phosphatic rock to ammonium phosphate by a reaction analagous to the manufacture of ammonium sulphate from gypsum. Under suitable conditions the yield has been found to be 16% of the total P_2O_5 content of the phosphatic ore.

5. Manufacture of Carbon Disulphide from Iron Pyrites. (J.C. Ghosh and Parthasarthy, Bangalore).

Carbon disulphide is in great demand by the rayon industry. The newly discovered iron pyrites of the Nilgiri Hills offers much scope for the production of carbon disulphide by the reduction of the pyrites with charcoal. Investigations have also been conducted on the suitability of various types of carbon, namely, coke, wood, charcoal and cocconut shell charcoal for the purposes of this reaction.

A pilot plant was set up for the manufacture of carbon disulphide.

6. Manufacture of Diethyl-phthalate. (S. S. Joshi, Benares.)

The method selected was the treatment of phthalic anhydride with ethyl alcohol in the presence of a dehydrating agent. With calcium chloride as dehydrating agent and under suitable conditions the yield was as much as 63.06%.

7. Manufacture of Potassium Perchlorate. (S. S. Joshi, Banares).
Processes No. 7. and 8 await utilisation.

OTHER ACTIVITIES AND FUTURE PROGRAMME :

1. The Geological Survey of India have been requested to carry on investigation on the beneficiation of the apatite mica of Hazaribagh, manganese bearing rocks in the Rewa Katni areas and the mica bearing-pegmatite ore of the Nellore district with a view to use them directly as fertilizers and in the manufacture of phosphatic fertilizers. The separation of haematite from apatite of the Singbhum district with a view to determine whether the former can be utilised in the iron industry is also under investigation.

2. Manufacture of lithopone is proposed to be investigated at the Delhi University Laboratories.

3. Mr. Gee of the Geological Survey of India is preparing a detailed note on quality and extent of pyrites in India with particular reference to the ore near Mirzapore.

4. Mr. Gee has sent a preliminary note on the phosphatic ores in India.

Fertilisers Committee.

Date of Constitution : August 1940.

Personnel :

Sir J.C. Ghosh	Chairman
Sir C.S. Fox	Member
Rai Bahadur B. Vishvanath	"
Director, Scientific and Industrial Research.	<i>Ex-officio.</i>

The Committee was merged into the Heavy Chemicals Committee in 1944 which should be consulted for further activities of this Committee.

PROBLEMS COMPLETED AND THEIR UTILISATION.

- (1) Production of Fertilisers from Phosphatic nodules of Trichnopoly (J.C. Ghosh and others, Bangalore).

Using a temperature of 1100°C and also making use of steam in the heating process, the phosphatic nodules after treatment gave about 17.0 percent of citrate soluble phosphatic fertiliser containing also available potash. In view of the fact that phosphatic deposits occur only in Madras and Bihar, the process has been revealed to the Madras and Bihar Governments for industrial utilisation and exploitation.

- (2) Manufacture of Ammonium Sulphate from Gypsum (J.C. Ghosh and others, Bangalore).

Pilot plant investigations on the manufacture of ammonium sulphate from gypsum have been carried out and the suitability of various kinds of Indian gypsum for this purpose has been examined.

(3) **Manufacture of Urea (J.C. Ghosh and others, Bangalore).**

Pilot plant experiments on the manufacture of urea from carbon dioxide and ammonia were conducted and special autoclaves for the semi-commercial scale production using different catalysts were constructed. In view of the fact that ammonia, the chief ingredient was easily available in Mysore in substantial quantities, it was decided to entrust the development of the process to the Mysore Government who undertook to arrange for the commercial production of urea at Bhadravati. Recently the Mysore Government have informed the Council that they no longer feel interested in this process and the question of leasing out the process to other parties is under consideration.

Sulphur Research Committee.

Date of Constitution : July 1940

Personnel:

Sir S.S. Bhatnagar	Chairman
Sir J.C. Ghosh	Member
Sir C.S. Fox	”
Prof. H. Krale	”

The Committee was merged into the Heavy Chemicals Committee in 1942.

PROBLEMS COMPLETED.

1. **Extraction of Sulphur from Baluchistan Ore. (C.S. Fox and coworkers).**

Native Sulphur was discovered in Baluchistan under the auspices of the Geological Survey at the instances of the Council and a process for its purification was developed. This investigation helped to relieve the serious sulphur shortage which prevailed during the war years to a considerable extent.

2. **Preparation of Sulphur from Iron Pyrites (S. S. Bhatnagar and J. N. Sarkar).**

The relations between temperature inside the furnace and the time of heating naturally disintegrated iron pyrites ores from the Sone Valley, mixed with unslaked lime, powdered lime stone and powdered metallurgical ore were studied. The gaseous mixture of sulphur, hydrogen sulphide and sulphur dioxide is passed through aluminium sulphate and cooled to give free sulphur.

3. Extraction of Sulphur and Sulphur compounds from Coal, Oil and Other Mineral Products (S. S. Bhatnagar and N. L. Dutt.)

The action of various organic solvents on Indian coals rich in sulphur compounds was studied. Steam distillation of coal was also tried. Most of the sulphur compounds in coal were found to be non-extractable. Mercaptans, and disulphides were found amongst the extracts obtained. Small quantities of sulphates were also obtained.

Exploratory Committee on Distillation and Other Chemical Plants

Date of Constitution : 1941

Personnel :

Sir S. S. Bhatnagar	Chairman
Mr. Kapil Ram H. Vakil	Member
Prof. P. Carter Speers	"
Mr. E. F. G. Gilmore	"
Dr. M. S. Patel	"
Mr. P. E. S. Warren	"
Mr. P. A. Narielwala	"
Mr. J. N. Lahiri	"
Mr. S. P. Sen	"
Dr. K. Venkataraman	"

This Committee has now been merged into the Heavy Chemicals and Chemical Industries Committee.

SCHEMES TERMINATED.

Manufacture of Rubber Lined Equipment for Chemical Industries (J. C. Ghosh & others, Bangalore).

Compositions and method for the electro-deposition of rubber and for the rubber lining of wood and of metal have been successfully worked out. For the latter ionic deposition of rubber by mechanical spraying has also been developed. The results have been covered by patents and the utilization of the results is under consideration.

OTHER ACTIVITIES.

The Committee were of the opinion that most chemical plants could be built in India, if the working drawings of some of them were

available. It may be possible to design and build units for general purposes, such as evaporators, vacuum stills etc., locally, especially if the sizes are not very large. Auxiliary equipment such as vacuum pumps compressors, fluid pumps etc., will have to be bought from outside for the present.

The Committee considered it difficult to generalise about chemical plants and were of the opinion that each problem would have to be carefully considered before expressing an opinion about the possibility of fabricating the plant locally. They suggested to the Government the appointment of a Standing Committee to which any enquiries for chemical plant could be referred for opinion. The Committee issued a questionnaire to all industrial workshops for the fabrication of chemical plants and their ability to undertake such fabrication. The information thus obtained was expected to form the basis for drawing up the future programme of the activities of the Committee.

Leather Research Committee.

Date of Constitution : December 1943.

Personnel :

Rai Bahadur B.M. Das	Chairman
Sir N. Seshachalam Chowdhari	Member
Dr. B.C. Guha	”
Mr. I.M. Marwar i	”
A Representative from the Leather and Saddlery Factory, Kanpur	”
Dr. S. Krishna	”
The Superintendent, Jullunder Tanning Institute, Jullunder	”
The Superintendent, Government Tanning Institute, Bombay	”
9. Director, Scientific and Industrial Research.	<i>Ex-officio</i>

The Committee has a five year programme of leather research, aspects of which are being worked out at the Tanning Institutes, Calcutta, Madras and Kanpur. Investigations are in progress in Calcutta on the mechanical flaying of carcasses, curing, tanning, leather finishing and other aspects of leather research.

The Imperial Council of Agricultural Research have been requested

to carry out field work for the elimination of damage to hides and skins due to disease and pest.

An improved flaying knife has been developed and attempts to introduce its use are being made. Steps for training of master flayers are also contemplated.

The Departments of Agriculture, the Inspectors General of Forests and the Forest Research Institute have all been requested to carry out a survey of tanstuff resources within their respective spheres. The Industries Departments under the Provincial Governments have also been requested to cooperate with the Chairman for co-ordination of research.

A proposal for a Central Leather Research Institute is under examination.

Dr. Venkataraman has been requested to prepare a note on wetting agents in leather industry.

Investigations on buffalo hides in the salted condition are in progress at Calcutta.

In order to avail of the facilities offered by the British Leather Manufacturers Association, which are only available to members, steps have been taken to enlist the Committee as a member of the British Association.

A long range research programme has been initiated at the Bengal Government Tanning Institute, Calcutta, and similar work is contemplated at the Madras University.

Plastics Committee

Date of Constitution : July 1940.

Personnel :

Sir J. C. Ghosh	Chairman
Dr. P. K. Bose	Member
Dr. Habib Hasan.	"
Dr. L. C. Verman.	"
Dr. S. K. K. Jatkar.	"
Director, Scientific & Industrial Research.	<i>Ex-officio</i> ,

PROBLEMS BEFORE THE COMMITTEE.

1. Production of Synthetic Methanol (J. C. Ghosh, Bangalore).
2. Preparation of Butadiene by the Inter-action of Acetylene and Ethylene (J. C. Ghosh, Bangalore).
3. Production of Formaldehyde from Power Alcohol (S. K. K. Jatkar, Bangalore).
4. Production of Polythenes by the Hydrogenation of Rubber Latex (J. C. Ghosh, Bangalore).
5. Plastics from Vegetable Oils (S. K. K. Jatkar, Bangalore).

SCHEME COMPLETED.

1. Production of Resins and Waxes from Vegetable Oils and Fats (M. N. Goswami and A. B. Chowdhri, Calcutta).

Oil waxes from different oils and fats of vegetable, animal or marine origin have been obtained. These waxes compare favourably with natural waxes such as carnauba wax, beeswax etc. and can serve as good substitutes.

2. Production of Urea and Melamin (H. K. Sen, Ranchi).

Methods for the production of urea were studied but the results could not be developed on a large scale due to the death of Dr. H. K. Sen.

3. Plastics from Seed Cakes (S. S. Bhatnagar and S. L. Verma, Delhi).

The protein present in oil seed cake was extracted by chemical treatment and then hardened. Mixed with fillers, pigments and plasticisers this hardened protein yields a good thermo-setting moulding powder which after baking of the mouldings at 70-80°C, yields mouldings comparable with phenol formaldehyde mouldings.

4. Plastic Collapsible Tubes (S. S. Bhatnagar and Prem Prakash Delhi).

In view of the acute shortage of lead and tin collapsible tubes during the war, plastic collapsible tubes made from resin-impregnated fabrics and plastic mouldings were prepared. The process was patented and leased

out to 3 firms for commercial exploitation. Large scale production could not however, be developed, as the war had by then terminated and metal collapsible tubes had become available in plenty.

5. Rosin Impregnation of Jute Mill Bobbins (S. S. Bhatnagar and others, Delhi).

Light woods lacking in hardness and strength were impregnated with resin forming solutions to impart strength flexibility, toughness and hardness to them. The wood becomes impervious to moisture and acquires useful physical characteristics. Packing case wood when treated in this manner yielded satisfactory results which were made available to Messrs. Tata Oil Mill Co., Ltd.

Jute mill bobbins similarly treated acquire additional hardness and long life. This process was leased out to Messrs. Shri Hanuman Sugar Mills Ltd., Calcutta and is also available to any other interested firm on payment of a recurring royalty.

OTHER ACTIVITIES OF THE COMMITTEE.

1. Drs. Karimullah and Ghatak have been requested to put a scheme for manufacture of maleic anhydride from turpentine fractions.

2. Information available regarding furfural has been placed at the disposal of the Chief Editor for incorporation in the Dictionary of Economic Products and Industrial Resources of India.

3. Having successfully prepared allyl alcohol from glycerine, Sir J. C. Ghosh has been requested to formulate a scheme for manufacture of polyhydric alcohols.

4. Production of (a) glycol from molasses (b) cresol (c) hexamine (d) acetic acid and (e) acetic anhydride in India is being investigated with a view to find out the requirements and production possibilities of these chemical essentials of the plastic industry.

5. Report on manufacture of cellulose pulp, an important raw material for cellulose nitrate, acetate and other cellulose plastics, has been called from Baroda.

6. Dr. Verman is putting up a scheme on "Fibres from Plastics" with special reference to an X-ray study of these fibres.

7. Enquiries for production of plastics from sugar and acids for sugar plastics are in hand.

8. Dr. Habib-Ul-Hassan is preparing a note on the manufacture of plastics from lignin.

9. A note on the chemistry and physics of high polymers with special reference to Indian raw material is being prepared by Dr. Jatkar.

10. A note on processing plant and moulding equipment for plastics industry is in preparation.

11. Research requirements for the plastics industry in the post war period are being ascertained from the Ministry of Industry and Supply.

12. In recognition of the important position which plastics occupy in the modern world, provision for a section on high polymers has been made in the National Chemical Laboratories.

13. A comprehensive survey of the research problems in 'Plastics' with particular reference to India has been completed under the auspices of the Committee. The report is being placed before the Board of Scientific and Industrial Research for necessary action.

Electro-chemical Industries Committee.

Date of Constitution : December 1943.

Personnel :

Sir J.C. Ghosh	Chairman
Dr. B.K. Ram Parshad	Member
Mr. G.C. Mitter	"
Prof. J.N. Mukherjee	"
Mr. P.B. Advani	"
Dr. Daya Swarup	"
Dr. L.C. Verman	"
Mr. V. Seshasayee	"
Director, Scientific and Industrial Research.	<i>Ex-officio.</i>

This Committee took over the functions of the Graphite Carbon and Electrodes Committee in 1943.

PROBLEMS UNDER INVESTIGATION.

- (1) Preparation of Graphite Electrodes with Metallic Salts, Linseed oil and various Resins (K.S. Krishnan, Allahabad).

- (2) Lead Anodes—Utilising Electro Refining Plant (Bombay Mint.)
- (3) Purification of Graphite and Manufacture of Graphite Crucibles and Colloidal Graphite. (J. C. Ghosh and K. K. Mazumdar, Bangalore).

A considerable amount of work has been done in this scheme and some of the valuable results obtained have already been made available in the form of a monograph published by the Council of Scientific and Industrial Research. The floatation method has been successfully employed in the purification of Indian graphite. Colloidal graphite in oil approaching in quality the well known Acheson's 'Oil dag' has been prepared from purified Indian graphite. The investigation continues.

- (4) Manufacture of Sodium and Magnesium by Electro-chemical Methods (J.C. Ghosh, Bangalore).
- (5) Reconditioning of Lead Acid Batteries (V.V.L. Rao, Madras).
- (6) Salvaging of Electrolytic Condensers (V.V.L. Rao, Madras).
- (7) Manufacture of Small Carbon Electrodes (G. D. Joglekar, L. C. Verma and D. Sen, Delhi).

The process for the manufacture of small carbon electrodes has been patented and leased to Messrs. Estrella Batteries, Bombay for commercial exploitation.

SCHEMES TERMINATED.

1. Chromium Plating of Glass and Other Non-metallic Materials (B.C. Car).
2. Manufacture of Graphite Crucibles (M. L. Joshi, Lahore).

Indian graphite has successfully replaced Ceylon graphite in the manufacture of graphite crucibles. The details of the processes were perfected and revealed to various firms engaged in crucible manufacture as technical advice free of charge.

OTHER ACTIVITIES.

1. Samples of ferro silicon alloys manufactured in Mysore have been supplied to Dr. Daya Swarup for preparation of a scheme on the use of materials as insoluble electrodes.

2. Steps have been taken to obtain information on manufacture of magnetite electrodes from Germany.

3. Mr. G.C. Mitter has been requested to prepare schemes on:

(i) Manufacture of plated electrodes

(ii) Recovery of primary metals from non-ferrous scrap.

4. Sir J.C. Ghosh has been requested to put up a scheme for research on electro-polishing of metals and alloys.

5. It is proposed to hold a joint meeting of the Central Technical Power Board and Electro-Chemicals Research Committee to consider all problems relating to development of electro-chemical and electro-metallurgical industries and research in the country.

6. Sir K.S. Krishnan has been requested to put up a comprehensive note on "Heavy Water."

7. A scheme on high purity manganese was sanctioned to be carried out at Indian Institute of Science, Bangalore.

8. A monograph entitled "Indian Graphite, its beneficiation and probable uses," has been published.

Graphite, Carbon and Electrodes Committee

Date of Constitution : July 1940.

Personnel :

Sir J.C. Ghosh	Chairman.
Prof. K. Aston	Member.
Capt. M.L. Joshi	"
Dr. L.C. Verman	"
Dr. D.S. Swarup	"
Director, Scientific and Industrial Research	<i>Ex-Officio.</i>

The Committee has now been merged with the Electro-chemical Industries Committee, to whom the schemes under investigation were also transferred.

SCHEMES INITIATED BY THE COMMITTEE.

1. Refining of Graphite from Mines of the Godaveri Area and Preparation of Graphite Lubricants, Celloidal Graphite etc. (J. C. Ghosh and K. K. Mazumdar, Bangalore).

2. Manufacture of Small Carbon Electrodes on Semi-large Scale (G.D. Joglekar, L.C. Verman and D. Sen, Delhi).
3. Manufacture of Graphite Crucibles (M. L. Joshi, Lahore).

SCHEMES TERMINATED.

1. Manufacture of Large Size Graphite Electrodes (K. Aston and M. B. Bhandarkar, Bangalore).

In this process carbon and graphite electrodes of $2\frac{1}{2}$ " and $1\frac{1}{2}$ " diameter were prepared. A large variety of carbons available in the country was investigated and of these, petroleum coke was found most suitable for this purpose. The process was leased out to the Aluminium Corporation of India, Asansol and Indian Industries, Travancore, but on account of the attitude adopted by the investigator who has floated the second concern, it has not been possible for Aluminium Corporation to go into production.

2. Manufacture of Carborandum and its Finished Products (K. Aston and V.N. Parthasarthy, Bangalore).

By suitably modifying the graphitising furnace, it was possible to prepare silicon carbide in both crystalline and amorphous varieties in high temperature furnace. Various factors affecting the final product were investigated but conclusive results could not be obtained as Prof. Aston, the main investigator, left India before the scheme could be completed.

Radio Research Committee

Date of Constitution : July 1942.

Personnel :

Dr. S.K. Mitra	Chairman.
Prof. M.N. Saha	Member.
The Chief Engineer, All-India Radio	"
Director-General of Observatories, Indian Meteorological Department, New Delhi	"
Prof. of Electrical Technology, Indian Institute of Science, Bangalore	"
Mr. S. R. Kantebet	"
Electrical Engineer-in-Chief Telegraph Store-yard, Alipore, Calcutta	"

W/c R.H. Holmes, Air Headquarters (India)	Member
Prof. H.J. Bhabha	”
W/Comdr. A.D. Jackson	”
W/Comdr. W.N. Craig	”
Dr. R.N. Rakshit	”
Dr. S.S. Banerji	”
Dr. M. B. Sarwate	”
Director, Scientific and Industrial Research	<i>Ex-officio</i>

SCHEMES UNDER INVESTIGATION.

1. Investigations on Radio Valves and their Manufacture in India (S.K. Mitra, Calcutta).
2. Ionosphere Investigations (S.K. Mitra, Calcutta).
3. Theoretical Investigations on Upper Atmosphere (M.N. Saha, Calcutta).
4. Directional Measurements of Atmosphere (Radio Research Committee).
5. Development of New Technique of Investigating the Ionosphere (S.K. Mitra, Calcutta).

The work on ionosphere investigation is one of the important investigations carried out under the auspices of this Committee. The ionospheric data from 5 different stations in India is collected and published every month and circulated to various ionospheric laboratories in the world. The investigations form part of the global investigations on this important subject.

SCHEMES TERMINATED.

1. Design of Electro Acoustical and High Frequency Apparatus (S.K. Mitra, Calcutta.)

(a) A process for the manufacture of carbon for telephone transmitters and microphones has been developed. The microphones have been tested and found good. A non-technical note has been published and the process is awaiting commercial utilisation.

(b) A process has been developed for the manufacture of energised type of loud speakers from Indian raw material. A non-technical note has been published and the process awaits commercial exploitation. (G. R. Toshnival, Allahabad).

2. **Manufacture of Cheap Radio Sets (G. R. Toshniwal, Allahabad).**

Superheterodyne sets have been assembled using carbon and mica resistances supplied by Prof. Aston and loud speakers made available by Prof. Mitra. These have given satisfactory performance. Volume controls could not be manufactured in India as suitable raw materials are not available. Cabinet designs were tested and improved.

3. **Cutting and Testing of Quartz Crystals (D. M. Bose Calcutta).**

Methods for cutting, polishing and testing of quartz crystals have been developed and crystals were cut with axes making various angles with the facets. Work has been suspended till the setting up of a powerful ultrasonic generator.

4. **Survey of Insulating Material and Dielectrics for High Frequencies (S. K. Mitra, Calcutta).**

Materials supplied by Government Porcelain Factory, Government Electric Factory, Mysore and the Lac Research Institute have been tested and found satisfactory.

5. **Design and Construction of Condensers and Resistances (K. Aston, Bangalore).**

Work was carried out on the construction of :-

- (a) Paper condensers
- (b) Mica condensers
- (c) Composition type resistances
- (d) Vitreous enamelled type resistances.

Processes were developed for the manufacture of serviceable articles and steps have been taken to patent the processes as a preliminary to manufacture on a commercial scale and exploitation.

OTHER ACTIVITIES.

Pilot plant for manufacture of radio valves is being imported from America.

PROPOSALS UNDER CONSIDERATION.

1. Investigation on 'Polarization of Down Coming Waves'.

2. Establishment of an ionosphere field station in the suburbs of Calcutta on the basis of a scheme submitted by Prof. S. K. Mitra.
3. Communication with the Posts and Telegraph Department for sending suitable signals for testing the accuracy of L. F. sets.
4. Survey of present position of radio industry in India.

Glass and Refractories Research Committee.

Date of Constitution : July 1940.

Personnel :

Mr. M. G. Bhagat	Chairman
Dr. A. Nadel	Member
Mr. I. D. Varshney	"
Prof. J. N. Mukherji	"
Prof. F. H. Ray (Representative of the Indian Ceramic Society).	"
Dr. D. N. Sen (Representative of the Bengal Glass Manufacturers Association.)	"
Dr. M. Qureshi	"
Mr. M. L. Joshi.	"
Dr. Atma Ram	"
Dr. Ashfaq Ali	"
Prof. P. R. Ray	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>

SCHMES UNDER INVESTIGATION.

1. Manufacture of Chemical Porcelain (H. N. Roy, Benares).
2. Manufacture of Better Glass Seggars (H. N. Roy, Benares).
3. Manufacture of Seger Cones (H. N. Roy, Benares).
4. Chemical Aspects of Increasing Plasticity of Pottery Compositions by Aid of Organic Substances (Delhi Labs. in collaboration with Bengal Potteries).
5. Optical Glass.

SCHEMES COMPLETED:

1. Purification of Glass Sands in India (A. Nadel and B. K. Mukherjee, Benares).

An economical process involving only sieving and washing has been developed for the purification of Indian glass making sands, particularly those containing iron oxide as impurity. The process has been developed and tested on a pilot plant specially set up for the purpose. It has been decided to furnish full details of the plant to all interested industrialists.

2. Manufacture of High Grade Refractory Clays (M. L. Joshi, Lahore).

Investigations on the manufacture of high temperature refractories used in the glass industries with special reference to (1) dry shrinkage (2) firing shrinkage at different temperatures ranging between 600°-1550°C (3) porosity of fired pieces at temperatures ranging between 600° and 1550°C (4) P. C. E. value test (5) tensile strength (6) corrosion test and (7) refractoriness under load test have been completed. Final reports from the author are awaited for consideration of development of the process.

3. Manufacture of High Temperature Graphite Crucibles (M. L. Joshi, Lahore).

Manufacture of graphite crucibles has been investigated on the following lines :

- (1) Study of clays as binding material,

- (2) Study of graphite ;

- (3) Manufacture of crucibles by shaping by hand press, drying and baking in muffle furnace and glazing with an alkaline glaze. Successful results in the application of varnishes on the crucibles to prevent absorption of moisture have been obtained. The results are awaiting exploitation.

4. Manufacture of Optical Glass. (I. D. Varshney, Bahjoi and M. L. Joshi, Lahore).

An extensive study of the different factors involved in the manufacture of optical glass has been made and special steps to eliminate veins and

striations have been indicated. A novel mechanical stirrer capable of working at 6 different speeds has been designed and constructed.

(5). **Manufacture of Ceramic Glazes and Colours** (G. Gopal Rao, P. T. Ramacharlu, Waltair).

As a result of exhaustive experimental study, various compositions for the fluxes and the stains to give various colours were evolved. The fluxes for the stains consisted of red lead, borax and silica in suitable proportion. The stains worked out include a good turquoise blue, light violet, scarlet red and light green. All these were obtained by proper treatment of suitable chemicals. The right kind and proportion of flux determined in many instances the development of the particular tint required. The results await development.

OTHER ACTIVITIES.

At its meeting held in September 1944, the Committee recommended that the principles guiding the availability to the industry of the results of the investigations carried out under the aegis of the Council should be (a) such results as are of a general and fundamental welfare to the entire industry should be given free to the entire industry and to no one else outside India, (b) results of a specialised nature should be made available on payment of royalties to such parties as are interested in that particular subject.

The Committee also recommended the designing and setting up a pilot plant at the Central Glass and Ceramics Research Institute for washing glass making sands.

A new scheme on survey of raw materials for glass and ceramic industry has been recommended. It is intended that this research should be completed in two years by the Geological Survey of India or failing them by the Council itself under the direction of Prof. D. N. Wadia.

The Government of India have been requested to invite Dr. Silverman of Pittsburgh University to advise on improving the quality of glass and ceramic ware in India.

A recommendation has also been made for approaching H. M. Government in the U. K. for revealing the patents and the secret processes relating to the optical glass manufacture available with them, to the industry in India.

Fuel Research Committee

Date of Constitution : July 1940.

Personnel :

1. Mr. A. Farquhar	Chairman
2. Dr. Sir J.C. Ghosh	Member
3. Dr. Charles Forrester	"
4. Dewan Bahadur D.D. Thacker	"
5. Mr. B. Wilson Haigh	"
6. Mr. K.S. Sen	"
7. Director, Geological Survey of India	"
8. Chief Inspector of Mines	"
9. Dr. N.N. Chatterjee	"
10. Dr. M. Qureshi	"
11. Mr. D.N. Wadia	"
12. Mr. R.F. Orme	"
13. Dr. J.W. Whitakar	"
14. Director, Scientific and Industrial Research.	<i>Ex-officio</i>

PROBLEMS BEFORE THE COMMITTEE :

The following schemes are being worked :—

1. Physical and Chemical Survey of Indian Coals.
2. Coal Washing.
3. Pilot Plant Work for the Desulphurisation of Indian Coals.
4. Spectroscopic Examination of Coal Fuels and their Combustion.
5. Low Temperature Carbonisation of Coal.
6. Coal Blending and Coking Research.

The investigation on coal washing is being carried out from the point of view of utilising the country's coal resources to the best advantage and form a very important item of the Council's technical activities, in which Tata are fully collaborating. A large number of coal samples from different seams have been examined for washability properties and the data collected is expected to be published soon. Hereafter, the data collected will be published every year. The setting up of a coal washing plant in the National Fuel Research Institute at a cost of Rs. 5 lakhs is under consideration.

SCHEMES COMPLETED AND THEIR UTILISATION:

(1) De-ashing of Indian Coals (S.S. Bhatnagar and G.S. Tewari). This investigation was undertaken with a view to obtaining low ash or

steady ash metallurgical coke, which is very much in demand in metallurgical processes. The process awaits utilisation.

(2) Briquetting of Hyderabad Coal (M. Qureshi and Srinivas Iyengar). Various factors such as fineness of coal powder, nature and amount of binder, shape of the briquettes, effect of pressure etc., and their influence on the final briquette produced have been studied. On account of their high ash content unlike coals of low ash content, Hyderabad coals are not suitable for briquetting by pressure alone. Briquettes prepared with 10% of the locally available binders, extracts of *Aloe Indicum* and *Sesamum Indicum* plants, compare favourably with good quality briquettes where bitumen has been used as a binder. Utilisation of the process is under consideration.

OTHER ACTIVITIES OF THE COMMITTEE :

1. Plans are ready to instal a Simon-Carves pilot scale experimental oven.
2. Enquiries are under way for the installation of an experimental scale coal washing plant at the Fuel Research Institute.
3. A note on the standard methods of analysis and more particularly the manner of recording and reporting results is under preparation.

Metals Committee.

Date of Constitution : November 1940.

Personnel :

Sir J. J. Ghandy	Chairman
Dr. D. P. Antia	Member
Mr. G. C. Mitter	„
Director, Geological Survey of India	„
Dr. D. R. Malhotra	„
Mr. R. Kamani	„
Mr. G. F. Gillat	„
Dr. D. N. Wadia	„
Mr. F. Adcock	„
Sir K. S. Krishnan	„
Dr. A. H. Pandya	„
Mr. J. S. Vatchagandy	„
Mr. R. A. M. Macqregor	} U.K. Corresponding „
Mr. E. V. Markinson	
Director, Scientific and Industrial Research	<i>Ex-officio</i>

SCHEMES UNDER INVESTIGATION.

1. Fatigue of Metals and Alloys. (F. Adcock, Bangalore.)
2. Grain Size Control of Ferrous and Non ferrous Materials. (Controller of Inspection (Metallurgical) Tatanagar.)
3. Production of High Purity Manganese. (F. Adcock, Bangalore.)
4. Manufacture of Electrical Resistance Alloys. (Mysore Iron Works, Bhadravati.)
5. Powder Metallurgy. (K. S. Krishnan.)
6. X-Ray Studies of Metals and Alloys. (K. Banerjee.)
7. Classification and Cataloguing of Technical Literature Relating to Metals. (Controller of Inspection (Metallurgical), Tatanagar.)
8. Manufacture of Sodium & Magnesium by Electrochemical Process. (J. C. Ghosh, Bangalore.)

SCHEMES COMPLETED:

1. Manufacture of Permanent Magnets (Tata Iron & Steel Co. Ltd.)

Posts and Telegraph Department sent samples of magnets required for their instruments. After prolonged investigation, Tatas prepared 5 sample steels and sent them for test. One of these was found suitable and the Government placed an order for 2½ tons of magnet steel bars which have been manufactured and supplied to the Posts & Telegraph Department.

2. Development of Copper Silicon Bronzes (D.R. Malhotra, Ajmer.)

Shortage of tin during the war required substitute bearing and other alloys like gun-metal and bronzes in which tin is not used as alloying metal. An investigation was therefore undertaken for replacing tin by silicon. Successful alloys with good bearing and machining properties were developed and it is hoped these silicon-copper bronzes can be very profitably utilized in the engineering trades.

3. Manufacture of Aluminium Titanium Alloys by Electro-Thermal Process. (Daya Swarup & V. J. Iyer, Benares.)

Various methods of producing titanium hardness have been tried and a simple and cheap process for the manufacture of hardness most suitable for aluminium alloys has been arrived at. Successful methods were developed for the production of alloys up to 15% Titanium.

OTHER ACTIVITIES OF THE COMMITTEE :

1. The Committee decided to ask the Government of India to limit export of ferro-manganese ore and chromite ore and take steps to conserve the country's resources and ensure an economic utilisation of the same.
2. A scheme for investigation of ternary systems of cadmium-zinc alloys at the National Metallurgical Laboratories is in preparation.
3. Detailed proposals for instituting researches on metal hydrides have been invited from Indian Institute of Science, Bangalore and Delhi Laboratories of the Council of Scientific and Industrial Research.
4. Attention of the Government has been invited to urgent necessity of prohibiting use of aluminium scrap for kitchenware in the interest of public health, pending investigations to ensure that these are not injurious.
5. Dressing of low grade ores. Pending establishment of a department of mineral ore dressing at National Metallurgical Laboratories, Ministry of Works, Mines and Power has been requested to arrange for a detailed survey of low grade minerals and institute research for beneficiation of ores wherever possible.
6. The Committee has offered its co-operation to the Indian Standards Institution in drawing up specifications for metals, alloys and manufactures thereof.

Applied Physics Research Committee.

Date of Constitution : July 1940.

Personnel :

Prof. K.S. Krishnan	Chairman
Dr. P.K. Kichlu	Member
Dr. Nazir Ahmed	"
Dr. S.K. Mitra	"
Dr. R.M. Chowdhuri	"
Supdt. Mathematical Instrument Office	"
Prof. M.N. Saha.	"
Mr. B.B. Bhowmick	"
Dr. G.R. Pranjpe	"
Director, Scientific and Industrial Research-	<i>Ex-officio</i>

Scientific Instrument Committee constituted in 1940 was amalgamated with the Applied Physics Research Committee. The problems under investigation were redistributed amongst the various committees.

SCHEMES UNDER INVESTIGATION :

1. Manufacture of Diamond Tools (P. K. Kichlu.)
2. Polar Crystals Dissolved in Glass (S. K. Majumdar.)
3. Setting Up of a Medium Voltage Positive Ray Apparatus (D. P. Bose, Calcutta.)
4. Manufacture of Vacuum Pumps, Compressors and Refregeration Machinery (M.N. Saha, Calcutta.)
5. Air Driven Ultra Centrifuge for Physical, Chemical and Biological Work (K. Ray, Calcutta.)
6. Design of Moving Iron Ammeters and Voltmeters on a Commercial Scale, Calcutta.
7. Manufacture of Permanent Magnets (B.B. Bhowmick, Calcutta.)
8. Manufacture of Glass Vessels of Various Shapes and Sizes, with Cemented Parallel Plates.
9. Manufacture of Photo Sensitizing Dyestuffs (D. N. Chowdhury.)
10. Investigations on Electrical Properties of Some Typical Order-Disorder Alloys (K.S. Krishnan, Delhi.)
11. Investigations on Thermoionic Work Functions fo Metals and Alloys (K.S. Krishnan, Delhi.)
12. Investigations on Alloys in Liquid State (K.S. Krishnan, Delhi.)
13. Setting up a Powerful Ultrasonic Generator (D. M. Bose, Calcutta.)
14. Investigations on Raman Spectrum and Luminescence of Organic Compounds at Low Temperatures (S. C. Sarkar.)
15. Chemical Effects in X-ray Emission and Absorption Spectra (G. B. Deodhar.)
16. Measurement of Absorption Coefficient for Sound Waves in Air and Other Polyatomic Gases (R. N. Ghosh)
17. Studies in Dielectric Constants of Liquids and Solids (S.K.K. Jatar, Baugalore.)
18. Ultrasonic Velocity in Gases and Vapours (P. C. Guha.)

SCHEMES TERMINATED.

1. Manufacture of Flash lamps (P. K. Kichlu.)

A process for the manufacture of flash lamps has been developed. A new flashometer was designed and constructed and the characteristics of these lamps have been examined and found to be as good as those of the best imported bulbs.

2. Manufacture of X-ray Tubes and Kenotrons. (P.K. Kichlu.)

X-ray tubes and kenotrons were successfully made and all technical difficulties found during the course of manufacture have been successfully overcome. Manuscript for publication is under preparation.

3. Manufacture of Photographic Developers (B.B. Day and Krishnamurthi.)

A successful method was developed for the production of para-aminophenol by electrolytic reduction of nitrobenzene in acid medium using catalysts. A patent has already been taken out. Metal could not be prepared even after prolonged investigations. Further work is in progress and will be completed under the Direct Cotton Colours Scheme.

4. Manufacture of Photographic Material in India. (G. Pranjpe.)

Air conditioned dark rooms were constructed and a model unit for manufacturing photographic emulsion on a semi-commercial scale was set up. Apparatus for testing and demonstration was also installed. Various types of plate emulsions were produced, distributed and tested. These were found satisfactory. A non-technical note on photographic plates is under consideration.

Plate coating machine having a length of 12 feet with an output capacity of 3000 full size plates per day was perfected. Subsequently a length of 10 ft. was added by means of a turn table.

Sensitive papers have also been produced by the aid of a model for coating papers with baryta and sensitive emulsions.

Exhibits were demonstrated at Bombay Art Society's 54th Annual Exhibitions in January 1945.

Special emulsions for plates, papers and X-ray plates have also been produced. The densitometer has been improved.

5. Manufacture of X-Ray Transformers (B. B. Bhowmick).

90 KV - 50 X-Ray transformer suitable for diagnostic X-ray work was constructed and transformer sent to Delhi. Subsequently with surplus material construction was undertaken of a H. T. 100 kv - 200 transformer, which also has been successfully constructed. Suitable compound filled bushing were designed for the Indian climate after prolonged investigations.

6. Radium Content of Indian Minerals and Mineral Springs (B. D. Nag Chowdhury.)

Beta-ray apparatus for quick and accurate estimation of uranium and thorium minerals in rocks was developed and constructed. Radioactive content of thorianite, pitchblende, uranium ochre and samarskite were determined.

Scientific Instruments Committee

Date of Constitution

July 1940.

Personnel :

Prof. M. N. Saha	Chairman
Dr. S. K. Mitra.	Member
Prof. K. Aston.	"
Mr. H P. Waron.	"
Mr. R. C. Malcolm.	"
Dr. A. L. Narayan.	"
Prof. G. R. Pranjpe.	"
Prof. P. K. Kichlu.	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>

The scope of field covered by this Committee was very wide and it was decided to set up a Metals Committee subsequently for research on raw materials for instruments.

The activities of the Committee were finally divided in 1942 between the Applied Physics Committee and Radio Research Committee. Details of the schemes originally initiated by this Committee are given under the respective committees to which they were transferred as none of the schemes had been completed before its termination.

SCHEMES INITIATED BY THE COMMITTEE :

1. Manufacture of Vacuum Pumps (M. N. Saha, Kamlesh Rai and Trepurendra Kumar Kundu.)
2. Design and Construction of Condensers & Resistances (K. Aston.)
3. Paper Condensers (K. Aston and C. Chandra Sekhariah.)
4. Resistances (K. Aston & V. N. Chinchalkar.)
5. Design of Electro Accoustical and High Frequency Apparatus (S. K. Mitra, Sarju Parsad and B. M. Banerji.)
6. Setting up a Powerful Ultra-sonic Generator (D. M. Bose and Bonbehari Ghosh.)
7. Manufacture of X-ray Transformers (B. B. Bhowmick and A. R. Chowdhri.)

Internal Combustion Engines Committee

Date of Constitution : February 1941

Personnel:

Sir J. C. Ghosh	Chairman
Prof. B. C. Carter	Member
Dr. M. Ishaq	”
Mr. A. J. Lund	”
Mr. N. W. Girjar	”
Rai Bahadur P. R. Agarwal	”
Sir L. P. Misra	”
F/Lt. K. N. Chawla	”
Lt. Col. H. M. V. N. Smith	”
Commander (E) J. Conerdale Smith R.N.	”
Mr. C. M. Latif Chowdhry	”
Director, Scientific and Industrial Research	<i>Ex-officio</i>

The Committee has surveyed the possibilities of establishment of Internal Combustion Engines industry in India and submitted a number of reports at the instance of the Committee. The Council of Scientific and Industrial Research has since created a Chair of Applied Mechanics at the Indian Institute of Science, Bangalore with a view to study the problems connected with the manufacture of internal combustion engines in India.

The Committee recommended the establishment of an Internal Combustion Engine Research Laboratory whose function would be

- (1) Testing and Certifying of Engines and Components.
- (2) Research on Internal Combustion Engines.
- (3) Fundamental Research.

This proposal was considered essential to meet the country's civil and military requirements and has been accepted. Preliminary planning of the Laboratory has been initiated and subject to Government approval, it is proposed to include research in aeroengines as well as research in naval craft engines (both surface and submarine) within the scope of the Internal Combustion Engines Research Laboratory. The Government of India has also been approached to arrange for training of the necessary personnel in their 'Overseas Studies Scheme'.

In view of the extreme importance of the industry the need for a separate Internal Combustion Engine Development Board has been keenly felt and proposal to that effect has already been made to the Government of India.

Committee on Statistics, Standards & Quality Control

Date of Constitution

December 1943.

Personnel :

Prof. P. C. Mahalanobis	Chairman
Mr. Kasturbhai Lalbhai	Member
Sir Padampat Singhania	»
Prof. N. N. Sen Gupta	»
Dr. P. V. Sukhatame	»
Dr. Zia-ud-din	»
Prof. K. B. Madhava	»
Mr. R. C. Bose	»
Dr. M. R. Siddiqui	»
Director, Scientific and Industrial Research	<i>Ex-officio</i>

The Committee discussed with Prof. R. A. Fisher, F. R. S., Balfour Professor of the University of Cambridge its activities and decided to concentrate on the following in the first instance :—

- (a) Standard and quality control with special reference to the development of Indian industries.

(b) Cost accounting.

(c) Application of statistical methods generally for improving the efficiency of industrial production.

With the above activities in view, it was decided to start a course of training in standards, quality control and application of statistical methods in industry at the Indian Statistical Institute, Calcutta, a grant of Rs. 12,000 being made for the purpose. It was also decided to develop a programme of research in collaboration with industrialists.

An introductory pamphlet on the importance of statistical methods in industry is under preparation and a sum of Rs. 2,000 has been sanctioned towards its publication.

A recommendation has been made to the Government of India to take suitable action for securing the adoption of uniform weights and measures throughout India.

Atmospheric Research Committee.

Date of Constitution : 1943

Personnel:

Prof. H. J. Bhabha	Chairman
Prof. M. N. Saha	Member
Prof. M. Ishaq	„
Prof. D. S. Kothari	„
Dr. S. K. Banerjee	„
Prof. S. Bhagavantam	„
Mr. M. K. Ramanathan	„
Dr. L. A. Ramdas	„
Director, Scientific and Industrial Research	<i>Ex-officio</i>

CURRENT PROBLEMS AND SCHEMES UNDER INVESTIGATION:

1. Radiation Equilibrium in the Atmosphere (K. R. Ramanathan, New Delhi.)
2. Photochemistry of Ozone, (P. K. Kichlu, Delhi University.)
3. Correlation of Cosmic Ray Intensity with Atmospheric Variables. (P. S. Gill, Lahore.)
4. Investigation of the Mechanism and Production of Mesons and their Properties with the Help of Wilson Cloud Chamber (R. L. Sen Gupta, Calcutta).

5. Infra Red Radiation from Atmosphere and Solar Radiation (L. A. Ramdas, Poona.)
6. Research on Upper Atmosphere (M. N. Saha, Calcutta.)
7. Research on Cosmic Rays (P. C. Bhattacharya, Calcutta.)
8. Measurement of Absorption Coefficient for Sound Waves in Air and Other Polyatomic Gases (R. N. Ghosh, Allahabad.)
9. Study of Formation of Vortices Both Theoretical and Experimental under Conditions Obtaining in Solar Atmosphere (S. K. Banerjee, Calcutta.)
10. Micro Waves Emitted from Extra-terrestrial-Sources (A. L. Rakshit, Calcutta.)
11. Work on Astro Physics, Experimental Physics and Cosmic Radiation (H. J. Bhabha, Bombay.)
12. High Altitude Measurement of the Penetrating Component of Cosmic Radiation and Ground Experiments on Mesons (H. J. Bhabha, Bombay.)

Although the committee was formed in 1943, it was only in 1946 and 1947 that the various research schemes have been initiated. All the schemes are under investigation.

Committee on the Measurement of Geological Time in India.

Date of Constitution: September 1946.

Personnel:

Mr. D. N. Wadia	Chairman
Sir J. C. Ghosh	Member
Prof. B. Sahni	"
Sir K. S. Krishnan	"
Prof. M. N. Saha	"
Director, Geological Survey of India	"
Dr. C. Mahadevan	"
Dr. P. B. Sirkar	"
Dr. B. D. Nag Chowdhury	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>

CHEMES UNDER INVESTIGATION:

1. Investigations on Chemical Composition of Tippers Collection of Rare Earth Minerals in India (P. B. Sirkar, Calcutta.)
2. Micro Palaeobotanical Investigations (B. Sahni, Lucknow.)

3. Measurement of Geological Time in India (M. N. Saha, Calcutta)

When the National Physical Laboratories come into being, it is proposed to have a scheme on "Geological Age of Rocks by Radio Active Methods in India". In the meanwhile the Government of India has been approached to make arrangements for training two students in this subject in the 'Overseas Scholarships Scheme'. A new scheme of research to investigate the uranium and radium content of south Indian rocks with a view to the determination of the geological age of the Deccan plateau is also under the consideration of the Committee.

Building Materials Research Committee

Date of Constitution : December 1943.

Personnel :

Sir T. S. Malik	Chairman
Prof. P. Ray	Member
Dr. A. H. Pandey	"
Mr. D. G. H. Teasdale	"
K. B. Md. Sulaiman	"
Mr. J. W. B. Gibbons	"
Principal, Thomason College of Civil Engineering, Roorkee	"
Mr. S. Sundaram	"
Mr. S. N. Chakrabarty	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>

It has been decided to establish a Building Research Laboratory in the chain of the National Laboratories being sponsored by the Council of Scientific and Industrial Research. Planning of this institute is in progress. Pending its establishment, a Building Research Unit has been established at the Thomason College of Civil Engineering, Roorkee where Research on building materials and construction is being undertaken. A sum of Rs. 90,000 has been sanctioned by the Government of India for this unit and staff for the same has been recruited.

During the past year preliminary work on some problems connected with the building industry has been initiated.

Beryllium Research Committee.

Date of Constitution : 1944.

Personnel :

Mr. G.C. Mitter	Chairman
Dr. Mata Prasad	Member
Sir. J.C. Ghosh	”
Dr. P.R. Ray	”
Director, Scientific and Industrial Research	<i>Ex-officio</i>

PROBLEMS BEFORE THE COMMITTEE.

Beryllium—Survey of Indian Resources and Manufacture of Suitable Alloys (P.B. Chakravarti and G.C. Mitter, Bombay and Bangalore.)

A survey of the literature on beryllium has been made and an analysis of Rajputana beryl has shown that it contains 12.05% of beryllium oxide. The methods of separating beryllium from aluminium have been studied and the optimum conditions for decomposing beryl with soda silicofluoride determined. Semi-large scale experiments on the extraction and preparation of beryllium chloride have been carried out. An arc furnace for the manufacture of copper beryllium alloys has been constructed.

Miscellaneous Research Schemes.

1. Manufacture of Sodium Cyanide (J.C. Ghosh and others.)

A method of manufacturing sodium cyanide was developed from indigenous raw materials namely commercial sodium carbonate, haematite and nitrogen. By suitable purification methods evolved during research, cyanide of 82% purity which satisfies most requirements of industry has been obtained. The results have been tried on a pilot plant scale.

2. Manufacture of Hydrogen Peroxide (J.C. Ghosh and others.)

Investigations conducted on the manufacture of hydrogen peroxide by the anodic oxidation of ammonium sulphate gave satisfactory results and yielded 3% solution of hydrogen peroxide. A pilot plant has been set up for the manufacture of 50 lbs. of 25 vol. hydrogen peroxide per day. Phenacetin and acetanilide have been used as stabilizers. A dilute solution of hydrogen peroxide (12 vols.) containing about 0.3% phenacetin retained 95% of its concentration after six months. The process is awaiting industrial utilisation.

3. Manufacture of Potassium Chlorate (J. C. Gosh, S. K. K. Jatar and B. Shah.)

A method for the indirect manufacture of potassium chlorate has been developed which will enable utilisation of some of the surplus chlorine expected to be available in the country in the near future as a result of the establishment of the alkali industry. In this method the starting material is first converted into calcium or magnesium chlorate and then interacted with a potassium salt to produce potassium chlorate. Valuable by-products like calcium chloride, magnesium chloride etc. are obtained and should go a long way towards reducing the cost of production. After pilot plant experiments, the process was entrusted to Messrs. Mettur Chemical and Industrial Corporation for development and the firm put up a plant and worked it successfully for 3 years. The working of the plant has been suspended for the time being due to the high market price of chlorine but it is expected that the process will be further developed when a surplus of chlorine is available in the near future.

4. Extraction of Thorium and Rare Earths from Monazite (P.B. Sirkar and others.)

The older methods of fractional crystallisation having been found to be very tedious and lengthy for the preparation of proserodymium and neodymium, a new chromatographic method has been developed. Extraction of thorium by the fluoride method was found unsuccessful but with higher (HCl) acid concentration the method yielded better results. The permanganate method for cerium gave good yield of cerium of high purity.

For the preparation of proserodymium and neodymium, animal charcoal was found to be most effective.

A complete modified scheme for the extraction of thorium and cerium has been worked out.

5. Manufacture of Phosphorus and Ferro-phosphorus (J. C. Ghosh.)

(a) *Phosphorus*.—The optimum conditions for the manufacture of yellow phosphorus by the electro-thermal smelting of phosphatic nodules have been worked out and a compact and efficient phosphorus recovery plant has been devised. A single phase furnace of an effective energy

output of 15-20 Kilowatts., has been installed. It has been found possible to obtain yields of about one lb. hourly with this furnace. The process awaits utilisation.

(b) *Ferro-phosphorus*—Investigation on the manufacture were started at the request of the President of the Metals Committee. It was found possible to obtain ferro-phosphorus of an average composition of 22% phosphorus. This works out to an average fixation of 60% phosphorus in the ferro-phosphorus.

6. Investigation on Sources of Plant Rennet (V. Subramaniyam and D.N. Hakim.)

Sources of rennet from a number of plants have been investigated. Many of these were found to be good sources of rennet. *Stieblus asper* (Urticaceae) has been found to be a suitable raw material for the manufacture of rennet. Rajahmundry and Salem districts are promising sources of supply.

Experiments have been carried out to adopt the rennets obtained for the Cheddar cheese manufacture.

7. Manufacture of Titanium dioxide from Ilmenite (J. C. Ghosh and others.)

A process for the manufacture of titanium dioxide from rutile has been developed. Samples of the pigment possess good tinctorial properties. The process is awaiting utilisation.

8. Manufacture of Duplicating Ink. (Miss. S. Ram.)

Analysis of some foreign duplicating inks was carried out and the process completed.

9. Utilisation of Waste Mica (R. C. Ray and Rustom Roy.)

(a) The possibility of utilising waste mica powder in thermosetting plastics has been investigated and the difficulties with regards to removing the articles from the mould and the low softening point of the composition have been overcome. The shellac-mica plastic has many advantages.

(1) All the raw materials are available in the country.

(2) It can be given bright colours.

(3) It can be easily worked on the lathe.

- (4) It is cheap ; at pre-war rates it should not cost more than $\frac{1}{3}$ per lb.

It may be possible to use mica-shellac plastics in the manufacture of cheap articles of every-day use as well as switches and other electrical appliances.

(b) Mica as lubricant and absorbent.

A permanent suspension of mica can be obtained by grinding the material previously heated at 800°C in an electric furnace and then dispersing it with 10% solution of sodium metabisulphite or by treatment with an emulsifier like aluminium stearate.

A composition for use as lubricant for moulds and cutting edges of tools was developed.

Investigations were also carried out to determine the gas-absorbing properties of thin laminated mica. Weight for weight mica absorbed CO₂ in the ratio of 2.1 : 10 as compared with charcoal. It also decolorises solutions, but as such has no preference over charcoal.

(c) Preparation of Mica Paint.

Experiments carried out reveal that paints from mica with amyl acetate as base possess better lustre than with linseed oil. Such paints can be used in spray painting as amyl acetate evaporates quickly.

A shining, fire-proof paint has also been manufactured from mica with amyl acetate.

10. The Manufacture of Gelatine. (Mata Prasad, Bombay).

Scheme for the manufacture of superior quality gelatine for food stuff, photographic emulsions and medicinal preparations etc. from cow and buffalo hide wastes, obtainable from tanneries was sanctioned in 1943.

The conditions necessary for obtaining the best gelatine for photographic purposes have been investigated and standardised.

This gelatine is slightly yellowish in colours and has a slightly lower melting point. Otherwise it approaches the imported gelatine in most respects.

Experiments to improve the quality are in progress.

Relations with Industry

RESEARCH SCHEMES

Apart from researches financed by the Council in the interest and for the benefit of the community and to meet the requirements of Government, the Council encourages the fullest use of science including conducting of research by industrial undertakings. Certain investigations were instituted with the approval of the original Board of Scientific and Industrial Research in its Laboratories at the instance of some private firms that came forward to meet the expenditure involved on condition of obtaining the results of such investigations entirely for themselves.

Five such schemes were instituted, the most important being the one by Messrs. Steel Bros. & Co. Ltd., pertaining to petroleum technology, vegetable oils and other allied problems. The second scheme was by Messrs. Ganesh Flour Mills Co., Ltd., Delhi with the specific object of arriving at a suitable composition for addition to hydrogenated vegetable oils to impart to them the flavour of natural ghee; the investigations also led to valuable data on vitamin fortification of hydrogenated oil products. The third scheme, sponsored by Messrs. Shalimar Tar Products Ltd., Calcutta was for the utilisation of tar products, particularly naphthalene; work conducted under this scheme led to pilot plant study and production of phthalic anhydride from naphthalene. Messrs. Jallo Rosin Co. Ltd., initiated a scheme of research for improvement of the properties of ordinary rosin and utilisation of low grade turpentine. The fifth scheme was financed by Messrs. Khatauli Sugar Works for the manufacture of plastics from bagasse, which on completion, are being developed commercially by the firm.

Unfortunately due to lack of adequate laboratory and other facilities, the above private schemes could not be continued after the termination of the first terms of contract, but it is proposed to make necessary provision for such cooperative research in the organisation of the various national laboratories which are being set up. Very recently a scheme of research on 'Vanaspati' has been sponsored by the Vanaspati Manufacturers' Association of India who have placed a sum of Rs. 45,000 at the disposal of the Council for the purpose. This scheme is now awaiting the acceptance of the Board of Scientific and Industrial research. In view of the fact that laboratory facilities with the Council are insufficient for working out the problems connected with this industry it is proposed to allocate

the problems to various other laboratories in the country where there are facilities for such work. For this purpose a Research Advisory Committee has been formed under whose guidance the investigations will be conducted.

Messrs. Steel Bros. Scheme.

I. UTILISATION OF PARAFFIN WAXES.

The object of this investigation was to find more uses for paraffin wax, other than making paraffin candles and impregnation of paper.

(i) A process for the catalytic oxidation of waxes into acids and aldehydes has been developed. The salts find use in rot-proofing and washing purposes.

(ii) Emulsions of waxes with latex have been prepared for water-proofing canvas. Such emulsions have good water-proofing qualities and the growth of mildew can be easily prevented by the introduction of a small percentage of an insecticide. The material produced answers standard test requirements.

II. ANTI KNOCK AGENTS.

This investigation was undertaken to find materials which increase the octane value of motor and aviation spirit. Preliminary tests on some of the materials developed yielded encouraging results.

III. POUR POINT DEPRESSANTS.

Pour point depressants are agents which when added to lubricating oils lower their congealing points. Lubricating oils produced from Burmese crude oils have appreciably high pour points on account of their comparatively high wax content. An excellent pour point depressant was produced by suitably treating naturally occurring Burma hydrocarbons. It has been found to compare very favourably with 'Parafflow', the standard imported pour point depressant.

IV. WOOD PRESERVATIVES.

Search for substances used for the impregnation of wood to prevent attack by termites and fungi has yielded satisfactory results. Samples sent to Forest Research Institute yielded satisfactory results.

V. SUBSTITUTES FOR GLASS (WINDOLITE).

Glass substitutes are used with a view to avoiding personal injury as a result of shattering of glass by explosions caused by aerial bombing and shelling. These, while capable of withstanding high wind pressure should be translucent material possessing great flexibility. A thin film of plastic material spread over wire gauze usually serves the purpose. After experimenting with various plastics and resins a suitable type of material using indigenous ingredients was produced. This can be rolled like wire gauze and answered the requirements. Due to difficulties in obtaining the wire gauze, the research had to be directed to another channel and the impregnation of cloth with a dope to render it translucent was developed. The dope was prepared from indigenous vegetable oil derivatives. The product was manufactured by the Indian Glass Substitute Co., Simbhaoli in very large quantities, approximately 2.5 million square feet being produced.

VI. PETROL-PROOF CANVAS BAGS.

Canvas bags which would not leak while holding petrol were required by the Defence Department. Several resins were tried on the surface of such bags and after a number of experiments a formula was evolved which gave satisfactory results.

VII. SEAMING VARNISH.

An off-shoot of the research on glass substitutes was the production of seaming varnish for antigas clothing. It is very effective for sealing up holes made in sewing garments and successfully withstood necessary tests at the Ordnance Laboratory, Kanpur. Large quantities of this varnish were supplied to meet defence requirements.

VIII. BITUMEN PRODUCTS (WOOD PRESERVATIVES).

Mixtures of emulsions containing bitumen were applied to render wood rot-proof. Solutions were made with fuel oil and incorporated with insecticides prepared from petroleum as well as vegetable oil derivatives.

IX. OBSCURATION CLOTH.

Material made from bitumen products when applied to cheap fabric base make them opaque and water proof. The product which is flexible and non-tacky can be used as a black-out material. Samples produced were approved by the Supply Development Committee.

X. LEAD-BRONZE BEARING OIL.

Indigenous vegetable oils, chemically treated to bring them to required viscosity and blended with vegetable oils gave very good lubricants for lead-bronze bearings. These blends were practically tested on certain railways and found suitable.

XI. ANTI-FROTH COMPOUND.

For preventing the frothing of glue, a soap was imported from abroad and used extensively by industry. A substitute has been prepared from indigenous material. It has the same degree of anti-frothing properties and is very effective.

XII. DE-EMULSIFIERS.

Crude oils form obstinate emulsions with water which are difficult to break. Proprietary material such as Icipol and Separator W are used for the purpose but were difficult to obtain during war time and, therefore, investigations to produce suitable agents locally were initiated. Substitutes prepared from soaps of vegetable oils were found satisfactory in regard to breaking up of emulsions. Samples were sent to Attock Oil Co., for practical tests.

XIII. VEGETABLE OIL LUBRICANTS.

Due to shortage of mineral oils consequent on war conditions, investigations were undertaken to find the possibilities to supplement the available stock of mineral oils by blending with vegetable oils. Several blends were prepared for light machine oil, spindle oils, oil for use in card and comb boxes of spinning and weaving mills as well as for running oil bearings of electrical motors, shafting and dynamos. The blends were put to actual tests by Messrs. Burma Shell Co., in different mills under working conditions under the observation of technical experts and compared favourably with mineral lubricating oils. They were found to be good substitutes for mineral oils and have been adopted largely in practice. Further investigations revealed that blends of castor, rape, and groundnut oils with mineral oils gave good results in the lubrication of the textile machinery except when the bearings contained brass. An addition which minimises reaction with brass was investigated and vegetable oil blends containing this reagent gave satisfactory results when tested in the mills.

Blends of rape and blown rape with mineral oils are now being marketed.

XIV. ROT PROOFING SAND BAGS.

The investigation was conducted at the suggestion of the Supply Development Committee. It was shown that scraps of brass could be converted into an effective rot proofing agent for fabrics.

XV. SOLUBLE OILS.

To replace imported products a satisfactory oil easily emulsifiable with water was prepared from castor oil and emulsifying agents. It is useful in leather treatment as a "Cutting" oil and finds other uses.

XVI. DRYING OILS.

The cutting off of the supply of tung oil led to a search for a substitute for use in the manufacture of paints and varnishes. The dehydration of castor oil with the help of various catalytic agents with a view to improving the drying properties of castor oil gave fairly good results. A semi-commercial plant was put up and put into production but for the production of a light coloured oil, vacuum heating was found to be necessary.

XVII. DECOLORISING EARTH.

Kashmir bentonite yielded an efficient activated earth with good bleaching properties. Scarcity of plant and sulphuric acid delayed the large scale utilisation of this process. Bauxite and Fuller's earth did not respond to this treatment.

XVIII. CANVAS WATER CONTAINERS.

Experimental proofings were carried out on behalf of the Supply Development Committee for field service trials of canvas water containers, water-proofed with bitumenous material.

XIX. LEATHER DRESSINGS.

Substitutes were prepared from indigenous material for imported leather dressings.

XX. BOOT POLISH.

A satisfactory formula for high grade boot polish using almost entirely indigenous material has been developed.

XXI. HYDROCARBONS FROM VEGETABLE OILS.

Lime soap of mahua oil on cracking yields 50% of an oil and the residue is a soft coke. This crude oil fractionates into three fractions.

- (a) 25% boiling in petrol range, which turns dark on standing and has very low octane value.
- (b) 50% boiling in kerosene range, green in colour and burns white well.
- (c) The remaining portion is a black oil which can be used as a Diesel fuel.

The crude oil itself deposits a wax on cooling with m. p. 77°C.

Mahua oil itself when cracked yields 52% of foul smelling distillate which is acidic with a pungent, irritating smell.

By cracking groundnut oil cake, a foul smelling alkaline distillate is obtained, which is soluble in water.

XXII. SUBSTITUTE FOR ROOFING FELT.

Hessian treated with coal tar pitch with fillers gives a satisfactory material for weather proofing.

XXIII. BRIQUETTES.

Using a cheap binding material, waste paddy husk can be converted into briquettes which can be more easily handled than waste.

XXIV. ANALYTICAL AND TESTING WORK.

A large number of diverse kinds of store materials were referred to for testing or analysis as a result of increasing cooperation between the R.A.F. and Council of Scientific and Industrial Research. This type of work is of immense value to the R.A.F. and sometimes brings out interesting features. Materials salvaged from enemy planes or other materials prepared for fulfilling special needs were also submitted to investigation. The following amongst others, were the items examined.

Bearing metals; aluminium casts; sheets or powders; solders; colloidal graphite; deposits from engine; oil from engines; pitch; duplicating paper; asbestos; cork coating composition; sulphuric acid; potassium cyanide; water; standard colour identification medium; starch; chromic acid;

paraffin wax ; glycerine ; ethylene glycol ; water clarifying powder ; soldering flux ; desalting permutit ; chloramine.

Investigations were also carried out on the rusting characteristics of cartridge metal links, vapour pressure and distillation characteristics of petrol and tests for the detection of carbon monoxide in aeroplane cock-pits.

XXV. ACTION OF HIGH TENSION ELECTRICAL DISCHARGES ON OILS.

A regular series of investigations on the action of high tension electric discharges on different vegetable and mineral oils which were being conducted at Lahore were continued but had to be suspended owing to other important work in connection with war. These investigations were of special importance as they were to form alternatives to the well known "Vol-tol" process which had been successfully developed in Germany. The results of the investigations so far conducted have shown that electric discharges have the property of cracking light mineral oils into lighter fractions while heavy mineral oils are polymerised to yield lubricants which are lighter in colour and possess better properties than the lubricants produced by the ordinary commercial methods. Vegetable oils also yield under this treatment heavier oils which can be used on heavy machines.

Messrs. Ganesh Flour Mills Scheme

FORTIFICATION OF VANASPATI WITH VITAMINS.

1. It was considered advantageous that Vanaspati should contain both vitamins A and D and also possess a colour similar to natural ghee. The addition of the vitamins from animal sources must be avoided to respect the religious susceptibilities of a large section of the consumers. Carotene obtained from carrots when added to artificial ghee imparts a yellowish colour and increases the vitamin potency but carrots are not a convenient or economic source of vitamins. A number of leafy vegetables containing a much higher percentage of vitamins were investigated, but they suffered from two drawbacks ; namely the fact that they imparted a greenish shade and the smell of an essential oil persisted in the final product. Attempts were made to overcome these objections, so that these inexpensive natural sources may be utilised commercially.

2. Flavouring of Vegetable Ghee. (Biochemical and other methods). The substance responsible for the flavour in butter or cream is diacetyl, produced by the action of certain bacteria on acetyl-methyl carbinol not

present in the product. The cultures known as "Starters" are added to the vegetable ghee and the growth is allowed to continue when diacetyl is produced and requisite flavour is imparted to the product. Further it is well known that butter milk contains a certain amount of this residual flavouring principle. To utilise this source, a combined fermentation and solvent action method has been developed to obtain the flavouring principle as a concentrate in a fatty medium. The principle is on trial on a commercial scale. The maximum dilution obtained, namely 1 : 200 appears to be too low for commercial feasibility.

An attempt was also made to prepare an artificially blended concentrate, different in composition from diacetyl. The constituents were so blended as to produce a natural effect. This concentrate is capable of much larger dilution.

FISH OIL AS A SOURCE OF VITAMINS.

A million pounds of fish oil is wasted in the process of drying fish in East Bengal alone. This natural oil after purification could be fortified and standardised for vitamins A and D. Besides the purified oil 5 to 8 percent stearin, which can be commercially utilised in making boot-polish and candles could be collected. 1 to 2% cholesterol, a medicine for anaemia can also be obtained. By biological methods and irradiation with ultra-violet rays, cholesterol can be converted to vitamin D. An investigation on this subject was conducted with useful results.

ISOLATION OF VITAMIN A FROM PLANKTON.

Plankton (Diatom) is the source of vitamin A found in sea fish liver, but the general belief was that this vitamin is synthesised in the fish liver from the diatoms on which they feed. Investigations were carried out on plankton collected from Madras coast by solvent extraction resulted in 2 to 3 percent of a viscous oily material, possessing nearly all the physical and chemical properties of vitamin A. It appears that vitamin A is present in the plankton as such.

The residue after extraction, which is rich in assimilable nitrogenous material can be utilised for the preparation of artificial foods.

VITAMIN C.

Tablets of Vitamin C from amla have been prepared using kaolin as absorbent, at a reasonable cost of production. Such tablets weighing $\frac{1}{2}$ to 1 gramme contain 1 to 2 mgm. of vitamin C.

Messrs. Jallo Rosin Co. Ld. Scheme.

These investigations consisted of many miscellaneous schemes enumerated below :—

Production of anti-knock dopes ; conversion of low grade turpentine to a useful resin ; manufacture of a turpentine substitute for plasticising ; conversion of ordinary coloured rosin to a very high grade material ; perfecting a pilot plant for distillation of rosin ; improving ordinary rosin so as to give a less brittle and high melting composition.

Messrs. Khatauli Sugar Works Scheme.

UTILISATION OF BAGASSE.

Bagasse is the fibrous material obtained when sugar cane is crushed for the juice. It is generally used as a fuel in the sugar mills.

(a) Bagasse contains a fair percentage of lignoresin. This could be converted to resin and the fibre structure of bagasse would give moulded articles of high tensile strength, free from the defects of wood, such as swelling under water or chipping off.

It was found that the bagasse fibre opened up when subjected to steam under pressure and the fibres which became soft could be moulded into boards without addition of any resin. This proved the formation of resinous matter in the process. Conditions of correct steam pressure to obtain a satisfactory product were worked out. A detailed investigation to find out the conditions best suited for producing wood substitutes combining the tensile strength of best woods and the water resistance of bakelite were carried out.

The boards produced have very satisfactory properties. They can stand an almost indefinite immersion in water, have a high impact strength and sufficient tensile strength. Their resistivity is very high, of the order of 10^{10} ohms. They can be used for making radio cases or articles where high resistivity is desirable.

THE BAGASSE RESIN.

The bagasse resin can be extracted with spirit after subjecting the fibre to suitable treatment. It is a dark brown lustrous solid, soluble in alcohol and aniline, and insoluble in benzene and vegetable and mineral oils. It has good binding and water-proofing qualities.

A detailed investigation of its physical and chemical properties suggested many uses for this newly discovered material. It has proved satisfactory in the manufacture of moulded and laminated articles. It offers a good potential source of cheap moulding powders for the manufacture of flat articles. The use of the resin can be extended for waterproofing tents and fabrics and in making spirit varnishes, paints and lacquers.

A patent covering this investigation has been sealed.

Cooperative Research Associations

The major extent of industry in India is conducted by comparatively small firms. Unlike large industrial undertakings which have their own research departments, small firms cannot afford to maintain adequate research sections in their works as research is costly and not always productive. Further, there are also problems which are of large range character and the solution of which will benefit a particular industry as a whole and cooperative effort is the only method by which research could be conducted. The Council, therefore, considers that the best method for encouraging industrial research in industry should be to encourage the formation of Research Associations established on a cooperative basis to serve the needs of particular groups of industries on the lines of such Research Associations in England. With this end in view necessary details have been circulated to various bodies in India connected with commerce and industry, with the request to place these details before their member firms and industrialists. Model Memorandum and Articles of Association have also been prepared and circulated to all the leading industrial associations and chambers of commerce so as to stimulate discussion and facilitate early formation of such research associations. In this matter leading industrialist members of the Council like Mr. Kasturbhai Lalbhai, have taken a lively interest. This interest has been largely instrumental in bringing together the Ahmedabad millowners to form a Textile Industry Research Association at Ahmedabad. Two other encouraging responses to these efforts are the moves by the All-India Chemical Manufacturers Association led by Dr. Hamied and by the Tanners and Leather Manufacturers especially in Madras towards the formation of such research associations for these industries. The replies received from others indicate that opinion amongst them has not crystallised and they are holding discussions amongst themselves. The Council will have to educate industry in the benefits of such cooperative effort and this will require considerable effort and per-

severance. But there is no doubt that one industry after another will appreciate the advantages of the scheme and by formation of its industrial Research Association reap the benefits that accrue from research. These Research Associations will by focussing attention on the particular problems of each industry form an important link between industry and the Council. The effort in education and encouragement for formation of such industrial Research Associations should form a growing phase of the Council's activities and assume an important role in the life of the nation.

BOARD OF RESEARCH IN ATOMIC ENERGY

The subject of atomic energy and harnessing it has been attracting the attention of scientists the world over for some considerable time. During the last world war the need for intensifying investigations in this intricate subject was keenly felt. The United Kingdom, the United States of America and Canada pooled their resources and research efforts so as to keep ahead of Germany. All developments in the subject were closely guarded secrets and it was not till the atom bomb had burst on Nagasaki and Hiroshima that the world came to know that atomic energy had been harnessed by man to meet his needs. Intensive investigations in this subject still continue in every country, the main object being to utilise the power released by atomic energy for industrial purposes.

In India, the importance of the subject has been duly appreciated and the Board of Scientific and Industrial Research appointed an Atomic Energy Research Committee in January 1946 with the following personnel :—

Dr. H. J. Bhaba	Chairman
Sir K. S. Krishnan	Member
Prof. M. N. Saha	”
Mr. D. N. Wadia	”
Dr. Nazir Ahmad	”
Dr. Jivraj N. Mehta	”
Director, Scientific and Industrial Research	<i>Ex-officio</i>

At the instance of this Committee, Sir S. S. Bhatnagar and Mr. D.N. Wadia visited Travancore and submitted a report on thorium deposits. The Committee recommended a country wide survey for uranium minerals by the Geological Survey of India and they have started work on the subject.

The Committee also recommended that the Tata Institute of Fundamental Research, Bombay should be the principal centre for work on atomic

energy. Ten young scientists were appointed to receive training in Nuclear Physics and its experimental technique at the Institute, the object being to send some of them abroad for further training.

The Committee has sanctioned a scheme for the establishment of a Beta-tron at the Institute. A scheme by Prof. D.M. Bose for research on trans-uranic elements, nuclear fission of heavy elements and absorption cross-section of neutrons at the Bose Research Institute, Calcutta has also been accepted. It has also been decided to meet a part of the expenses being incurred by the Calcutta University in setting up a Cyclotron Laboratory. A sum of Rs. 1,15,000 has been sanctioned for this purpose.

In view of the vast field covered by atomic energy research, it was felt that the problems connected with it should not be handled by a small Committee of the Board of Scientific and Industrial Research. The Government of India and the Council of Scientific and Industrial Research therefore decided in June 1947 to set up a Board of Research in Atomic Energy with the following personnel:—

Dr. H. J. Bhabha	Chairman
Sir K. S. Krishnan	Member
Prof. M. N. Saha	”
Mr. D. N. Wadia	”
Dr. Nazir Ahmad	”
Dr. D. M. Bose	”
Dr. M. S. Krishnan	”
Dr. Jivraj N. Mehta	”
Director, Scientific and Industrial Research	<i>Ex-officio</i>

This Board will work directly under the Council of Scientific and Industrial Research (and not through the Board of Scientific and Industrial Research) and will carry out the following main functions:—

- (a) To plan, finance and carry out atomic research and development throughout India.
- (b) To explore the availability of raw materials connected with the generation of atomic energy and to advise Government on the control, utilisation and export of such raw materials in India.
- (c) To provide the machinery for cooperation in matters of atomic energy, research and development with corresponding bodies and to advise Government on any agreements with foreign powers that may be necessary for the purpose.

- (d) To appoint committees and take all other steps in furtherance of the aim of developing atomic research and energy to the fullest extent in India.

At the same time a joint committee with the representatives of the Travancore government for research and development of atomic energy from Travancore minerals was also set up. The personnel of this committee is as follows :—

Dr. H. J. Bhabha	Chairman
Prof. M. N. Saha	Member
Mr. D. N. Wadia	”
Dr. Nazir Ahmad	”
Dr. M. S. Krishnan	”
Dr. K. L. Moudgill	”
Mr. K. P. Menon	”
Dr. V. Mahadevan	”
Director, Scientific and Industrial Research	<i>Ex-Officio</i>

The joint committee will also work under the general supervision of the Council of Scientific and Industrial Research through the Board of Research in Atomic Energy and will be recognised by the Government of Travancore as the sole advisory body in all matters appertaining to the development of atomic energy and research including the utilisation and the disposal of radio-active raw materials.

UTILISATION AND DEVELOPMENT OF RESEARCH.

It is common knowledge that there are many practical difficulties before the results obtained in the laboratory can be translated into factory production and the products of research are brought before the public as finished material. The solution of these difficulties requires technical knowledge and skill and the want of these together with the unknown factor of financial costs involved, generally acts as a deterrent in a proper appreciation of the laboratory results and in most cases the industrialist feels shy of taking up new processes, fresh from the test tube, and investing his capital in putting them on a production basis. On the other hand, the over zealous new comer in the field of industry is prone to take up everything that comes his way irrespective of his capabilities and the capital at his command. In this case the result of entrusting a process for development to such a party would be the great danger of the process being wrecked and the valuable laboratory researches being lost, at least for the time being.

An appreciation of these factors would bring to the forefront the importance of ensuring a proper utilisation and development of research results and it is in realisation of the difficulties involved in a proper utilisation of research that the Council of Scientific and Industrial Research has a separate utilisation branch to deal with the results as they are reported by the research scientist from time to time. The importance of the subject was realised by the government soon after the creation of the Board of Scientific and Industrial Research, by the setting up of the Industrial Research Utilisation Committee in 1941, one year after the Board was created. The functions of this Committee have already been stated and until recently this committee has continued to function and tender advice to the Council of Scientific and Industrial Research directly or through its standing committee. From the 1st April 1947 the Industrial Research Utilisation Committee has been abolished and replaced by a more compact body, the Industrial Liaison Committee. The duties and functions of the Industrial Liaison Committee remain the same as those of the late Industrial Research Utilisation Committee.

When the progress of a particular investigation is reported to the Board of Scientific and Industrial Research to have reached the stage of completion, and the investigation is considered to be ready for development and commercial exploitation a non-technical note on it is passed on to the utilisation branch. Here the non-technical note is carefully scrutinised by a Technical Officer and the Industrial Economist and Research Development Officer of the Council with a view to examine the technical aspects and economic implications thereof and information about the capital required for both block and recurring expenditure, necessary equipment, supply of raw materials available, market prices and estimated cost of production is checked up. The note is then placed for final scrutiny before an *ad hoc* committee, which consists of these two officers, the investigators concerned, the Director, Scientific and Industrial Research or his representative and an outsider (industrialist, departmental representative or expert) closely associated with the line.

After the non-technical note has been scrutinised and modified by the *ad hoc* committee it is printed and circulated to various chambers of commerce and other commercial bodies and industrial concerns with an invitation to tender from those desirous of taking up the process. Non-technical notes are also published in the Journal of Scientific and Industrial Research to ensure wide publicity.

The offers received as a result of the circulation and publicity are considered by the Industrial Liaison Committee which examines them in the light of the following procedure and decides the manner in which the process is to be commercially developed and exploited. This procedure was prescribed by the Industrial Research Utilisation Committee at its first meeting on the 12th February 1941 and still constitutes the basic principles guiding the activities of the committee.

(1) Research schemes which could be exploited without much capital investment or the erection of plant and machinery or as cottage industries and were of general public benefit, might be released to the public without any conditions regarding royalty being attached thereto.

(2) With reference to other research schemes, applications should be invited on the widest scale possible from those interested in the development of such research schemes.

(3) Any information regarding the nature of schemes should be circulated to all chambers of commerce, all associations of commercial and industrial bodies, to associations of employers, to banks, investment corporations and associations of insurance companies.

(4) In selecting the individual concern or concerns which would develop the research, regard might be had to the following considerations:—

- (i) The financial resources of the individual concern or concerns.
- (ii) The technical skill available.
- (iii) Advantages in the matter of raw materials required ; the availability of power and necessary labour, and transport facilities including proximity to markets.
- (iv) Financial terms relating to royalty.

(To these some further considerations relating to the organisation of the interested companies, both existing and newly promoted, have been added from time to time).

Generally speaking, regard should be had to the proper location of the industry and the number of concerns which could utilise the research without over production.

Regard may also be had to the facilities for future research which the concern or concerns were prepared to offer.

(5) Government might allow patent rights to be exploited subject to such terms as might be considered desirable having regard to the nature of the research scheme. If within a reasonable period no steps were taken or very inadequate steps were taken to utilise the results so made available, Government would have the power to withdraw the concession and offer the exploitation of the research scheme to other concerns.

(6) Where there was no question of patent rights with reference to a research scheme and only a secret process was involved such secret process might under like conditions be handed over to any industrial concern or concerns.

(7) The question of allocation of any royalties as between the Central government and any provincial government or institution might be left to be decided by the Central government in consultation with the provincial government or institution, if necessary on the merits of each case. The distribution of that portion of the royalty allocated to the scientists responsible for the research would be on the basis of equality as amongst the scientists associated with that research.

As regards distribution of royalties, as referred to in para (7) above, one-third of such an amount had been fixed for distribution among the research workers concerned. But the procedure of disbursement as among the scientists responsible for the research, as contemplated therein, has since been modified and the disbursement of the scientists' share is now being made in such manner as may be indicated by the principal scientist responsible for the guidance of work on the problem.

From the above details, it will be seen that the procedure adopted by the Council for leasing out its processes provides for adequate publicity and aims at attracting the attention of a wide circle of industrialists in the country and stimulating their interests in undertaking commercial exploitation of the processes offered by the Council.

The standard agreement form under which the Council leases out its processes contains a clause providing for the Council giving the licensee all facilities and technical advice and assistance including, if needed, services of a technical expert to ensure the process being placed on regular commercial production. This is a valuable provision which takes cognisance of the fact that it is in the interest of both the Council and the licensee that production is commenced in a proper manner. This provision has been availed of by some of the licensees with considerable advantage.

The development activities of the Council have been continuously increasing and these have grown so important as to require the organisation of a special 'Utilisation' branch in the Council's secretariat placed in charge of an Assistant Secretary (Technical) who collaborates with the Industrial Economist in regard to the technical aspects of non-technical notes and has to keep a watch over timely realisation of royalties from the licensees according to their progress reports and other duties involved in or allied to the execution of the leases.

The Council has so far leased out 43 processes (shown in the following statement) for commercial exploitation to private bodies and has earned a total income of Rs. 1.98 lakhs to date as premia and royalties.

The Council's income under this head, however, represents only the money value and is a fraction of the actual benefits derived by the country from the activities of the Council. A very large number of the processes developed under the aegis of the Council related to investigations of direct war importance and have been handed over to the Supply Development Committee of the Supply Department, R. A. F. and U. S. A. A. F. free of cost. The benefits derived from these processes cannot be translated in terms of money but are expected to be very large, as the production from some of these is individually known to have been valued at crores of rupees. This is particularly true of such processes as Antigas Cloth, Vegetable Oils as Lubricants and Fuels, Air Foam Solution etc. All these are regarded as a valuable contribution to the war efforts made by the Council during the last few years.

In addition to these quite a few processes have been passed on to Provincial governments and Indian states for utilisation free of cost. Some others have been released to the public free of cost in accordance with the Council's policy towards utilisation enunciated in the preceding pages.

Mention must also be made of benefits derived from improvements in existing processes, the total money value of which it is not possible to evaluate as no data with regard to these is available. These improvements result in recurring savings every day but an idea of the amount can only be gathered by the manufacturers concerned and the information is hardly ever conveyed to people not directly connected. It is very difficult, if not impossible, to assess the total value of such benefits which though direct have to be classified as indefinite benefits. That such processes do entail considerable benefit to the industry and the country is beyond doubt.

Processes so far leased out by the Council of Scientific and Industrial Research.

PROCESSES	To WHOM LEASED OUT.	TERMS (Royalty).
1. Air Foam Solution.	Fire Extinguisher Corporation, Calcutta.	Against premium and recurring royalty of 2½% on sales.
2. Bhilawan Stoving Enamel & Allied Products.	Jay Engineering Works, Ltd., Calcutta.	Against premium and recurring royalty of As. 3 per gallon.
3. Glass Substitutes.	Indian Glass Substitute Co., Simbhaoli, Distt. Meerut.	Against premium and recurring royalty of As. ¼ per sq. Yd.
4. Identity Discs.	1. Bharat Rubber Works, Barrackpur. } 2. A. K. Sarkar & Co., Calcutta. } 3. Nanco Rubber Works, Coimbatore. }	Rs. 2/- per 1000 discs marketed.
5. Jute Boards.	1. Karam Chand Thapar & Bros., Ltd., Calcutta. } 2. Juggilal Kamlapat, Kanpur. }	Against premium and recurring royalty of 3%.
6. Laminated Paper Fibre Boards.	Rohtas Industries Ltd., Dalmianagar.	Against premium and recurring royalty of As. 1 per lb.
7. Luminous Paints and Pigments.	Muraka Paint & Varnish Works, Ltd., Calcutta.	Against premium and recurring royalty of 2½% on sales.
8. Oil Silks.	B. N. Elias & Co., Ltd., Calcutta.	Against a fixed premium.
9. Potassium Chlorate.	Mettur Chemical & Industrial Corporation, Mettur-Dam.	Against 1/3rd of profit after the capital has been paid up.

PROCESSES	TO WHOM LEASED OUT	TERMS (Royalty).
10. Plastic Collapsible Tubes.	1. Premier Suppliers, New Delhi. 2. Radhakant & Co., Allahabad. 3. Heberlian Gareh & Co., Delhi. 4. Fazalbhoj (Bombay) Lab., Ltd., Bombay. 5. Das & Co., Bombay. 6. H. S. Mohamed, Bombay. 7. Industrial Products (I), Ltd., Delhi. 8. B. R. Herman Mohatta Ltd., Karachi. 9. Bharat Carbon Ribbon Mfg. Co., Ltd., Lahore. 10. S. N. Sankaralinga Iyer, Esq., Madras.	Against recurring royalty of 5% on sales.
11. Silver Paper & Glossy and Transparent Paper.	Karam Chand Thapar & Bros., Ltd., Calcutta.	Against a fixed premium.
12. Small Carbon Electrodes.	Estrella Batteries Ltd., Bombay.	Against a lump-sum premium.
13. Solid Fuel.	The Diamond Chemical & Pharm. Ind. Ltd., Lahore.	Against a fixed premium and recurring royalty of As. 1 per lb.
14. Stearic & Oleic Acids.	Calcutta Chemical Co. Ltd., Calcutta.	Against a fixed premium and recurring royalty of Re. 1 per cwt.
*15. Cork Substitutes.	1. Cork Product Co. Ltd., Baroda. 2. Delhi Cloth & General Mills Ltd., Delhi.	Against a fixed premium and recurring royalty of pies 6 per lb.

PROCESSES	TO WHOM LEASED OUT	TERMS (Royalty).
16. Treatment of Manganese Ores for Dry Cells Manufacture.	Estrella Batteries Ltd., Bombay.	Against a lump-sum premium.
17. Water Proof Paint for Indianite Roofing Slabs.	Karam Chand Thapar & Bros., Ltd., Calcutta.	Against recurring royalty of 1/24 As. per sq. ft.
18. Formaldehyde.	Indian Institute of Science, Bangalore.	Against payment to the Council of 24% of net profit.
19. Petrol Pump Diaphragms.	United Trading Co., Delhi.	Against a fixed premium and recurring royalty of 5% on sales.
20. Indigenous Moulding Powder SHP.	Mr. S. N. N. Sankaralinga Iyer, Madras.	Against a fixed premium and recurring royalty of 2½% on sales.
21. Vacuum Pumps.	1. The Scientific Apparatus & Chemical Works, Agra. 2. Shree Hanuman Sugar Mills, Ltd., Calcutta.	Against recurring royalty of 5% on sales.
22. Dye Extracts and Dyed Shades on Wool and Cotton from the barks of <i>Terminalia Arjuna</i> & <i>Butea Frondosa</i> .	Howrah Trading Co., Calcutta.	Against recurring royalty of 5% on sales.
23. Dye Extracts and Dye Shades on Wool from Tamarind Seed Testa.	Howrah Trading Co., Calcutta.	Against recurring royalty of 5% on sales.

PROCESSES	TO WHOME LEASED OUT	TERMS (Royalty).
*24. Anatto Dye Extracts.	Dairy Products & Equipment Mfg. Co. Ltd., Amritsar.	Against recurring royalty of 5% on sales.
25. Atoxyl and Carbarstone.	Zandu Pharm. Works, Ltd., Bombay.	Against recurring royalty of 2½% on sales.
26. Dettol Type of Disinfectants.	The Bengal Chem. & Pharm. Works, Ltd., Calcutta.	Against a fixed premium and recurring royalty of 5% on sales.
27. Resin Impregnation of Jute Mill Bobbins.	1. Sbrree Hanuman Sugar Mills Ltd., Calcutta. 2. Turpentine Subsidiary Industries Ltd, Jawalanagar, Rampur State.	Against recurring royalty of 2½% per cwt.
28. Extraction of Potash Salts from Molasses.	1. Ganesh Sugar Mills, Anandnagar. 2. Khaitan Sons & Co., Calcutta.	Against recurring royalty of 2½% on sales.
29. Calcium Gluconate.	Gluconate Ltd., Calcutta.	Against recurring royalty of Anna 1 for every ten lbs. of the product manufactured.
30. Carbon and Graphite Electrodes.	Aluminium Corporation of India.	Against recurring royalty of 2% on sales.
31. Butter Paper.	Dr. K. A. Hamid, Bombay.	Against lump-sum premium.
32. Tin Lining Compound.	Renderian Rubber & Chem. Works, Delhi.	Against recurring royalty of 5% on sale.

PROCESSES	TO WHOME LEASED OUT	TERMS (Royalty).
33. Fluids used in Hydraulic Machines	Indo-Burma Petroleum Co., Ltd., Bombay.	Against recurring royalty of 3% on sales.
34. Ebonite Substitutes and Other Hard and Soft Rubber Goods from Rubber Waste.	Renderian Rubber & Chem. Works, Delhi.	Against recurring royalty anna per lb.
35. Manufacture of Solid Metal Polish.	Metal Polish Works, Qadian (Pb.)	As technical advice on payment.
36. Manufacture of Pyrethrum Emulsifier.	Imperial Technical Works, New Delhi.	Against a fixed premium.
37. Manufacture of Resin and Plasticiser dopes.	Hassan M. Mullick & Co., New Delhi.	Against a fixed premium and recurring royalty of 2½% on sales.
38. Manufacture of Steam Proof Plastics.	The Olympic Rubber Works, Ltd., Calcutta.	
39. Manufacture of Crown Cork Cement.	The Simplex Mfg. Co., Ltd., Delhi.	As technical advice on payment.
40. Process for the Utilisation of Nim Oil and its Bitter Constituents (Nimbidin Series) in the Pharmaceutical Industry).	The Birla Laboratories, 64, Pathuriaghat Street, Calcutta.	Against lump-sum premium and recurring royalty of 2½% on sales.
41. The process for the manufacture of Sintered Glass Filters.	M/s. The Industrial & Engineering Apparatus Co., Ltd., Bombay 7.	Against recurring royalty of 10% on sales.
42. Manufacture of Rubber Sponges.	<ol style="list-style-type: none"> 1. M/s. Khaitan & Sons Co., Calcutta. 2. K. B. Industries Ltd., Nagpur City, C.P. 3. Shri Dinesh Mills, Ltd., Baroda. 	Against recurring royalty of 1% on sales.
43. Dipped Latex Goods.	<ol style="list-style-type: none"> 1. Dhanjal Industries, Hoshiarpur. 2. Nanco Rubber Works, Coimbatore. 	As technical advice on payment.

Amongst the indirect benefits may be mentioned the increased earnings in income-tax, super-tax, excess profits-tax and corporation-tax besides provincial and local taxes, which accrue to the Central government as a result of the profits derived by industry from the Council's processes. To these might be added the benefits derived by the country's economy from savings in exchange resulting from diminution of imports of products developed from several of the processes. In addition to these the industries and processes developed have provided employment to a considerably large number and the provision of this additional employment to labour brings in its train innumerable benefits which it is difficult to detail.

To take one concrete case only, it is estimated that vegetable oil lubricants valued at Rs. 5 crores were produced by the oil companies from the processes worked out by the Council. The Council did not derive any direct monetary benefit from this process but if the oil companies made a net 10 per cent profit on these, they paid taxes on Rs. 50 lakhs profit and if this figure is worked out it will come to quite a substantial amount. In addition to this some 50,000 tons of shipping space with its sea freight and handling charges was saved and if this is calculated, the savings will amount to a handsome figure. Similarly anti-gas cloth valued at over 1 crore of rupees was manufactured from the Council's formula. Here again the Council did not derive any direct monetary benefit but the indirect benefits to the country's economy will be found to be considerable.

Many of the processes developed and leased out for commercial exploitation have not come up to production stage as yet as the necessary raw materials were in short supply or the capital equipment for these was not available. With the expected easement of position with regard to these it is expected that production in these cases will be possible in the near future.

A list of processes evolved is given in the Appendix. This list includes both patentable and non-patentable processes. Many of these processes were developed for meeting emergency requirements created by war condition. In view of the changed circumstances due to cessation of hostilities, it has not been possible to exploit commercially some of these processes and they have not been utilised on a production basis. In other cases, there are a few processes which were placed on production and

yielded marketable products but are not now profitable or marketable as the competitive product or the product replaced is now easily available and in some cases at a cheaper price too. In these instances the buyer naturally feels shy of purchasing substitutes. The economics of these processes are, however, being examined with a view to reduce costs and provide scope for competition. Attempts are also being made to improve the qualities of the finished material. In this connection it may be pointed out that it is possible that a national emergency may arise when it may become necessary to consider restarting the processes which are at present lying neglected or abandoned. It is also possible that a stage may be reached when India may be in a position to develop and produce the raw materials required for some of the processes and render their commercial production economically advantageous.

The total expenditure on promotion of research by the Council of Scientific and Industrial Research since its inception on 1st April 1940 amounts to Rs. 65 lakhs approximately. When all the benefits derived from the activities of the Council by the Supply Development Committee, R.A.F., U. S. A. A. F., R. I. A. F. and the Defence Department the value of which cannot be translated in terms of money, are considered, the processes which have been released to the provincial governments, states and the public free of cost are taken into consideration, when cognisance of the difficult conditions under which the Council was created and the difficulties of lack of material and equipment which it had to face in its working is taken, the only conclusion possible is that the Council has more than justified its existence and there would be no hesitation in pronouncing it an unqualified success from all points of view. It has repaid many times over, the money spent on it when direct and indirect benefits derived by the government and the country from the activities of the Council are remembered. It is hardly necessary to add that there are still many processes which were leased out but have not yet gone into production due to want of equipment and raw material. There are still quite a number which are yet to be leased out and not quite a few which are lying abandoned and neglected at the moment but which are expected to be improved and revived in the near future. A brief review of all these processes has been made in the appendix and it is anticipated that with the expansion of its activities and with the rapid industrialisation of India in the near future, say within the coming ten years, the Council has a right to expect a very brilliant and resplendent future.

Mention at this stage must also be made of the valuable contributions towards advancement of learning and fundamental sciences as a result of the technical and scientific publications by the Council's scientific staff. A list of these is to be found in the appendix and through these the Council has gained in stature and ensured for itself a place in the scientific world. Particular mention in this connection must be made of the investigations on the indigenous plant products including the isolation and study of their physiologically active substances of medicinal and insecticidal value, plant antibiotics and a series of papers on the effects of ultrasonics on vegetable and essential oils from the Delhi laboratories of the Council. Many of these publications have found reference in standard works in their respective fields and have contributed in no small measure to the eminent position which the Council occupies in the scientific world of today.

Whilst on this subject, it is perhaps not out of place to point out that the utilisation and development of research results is a difficult problem in itself to which considerable thought and time has been and is being devoted in other countries particularly in the United Kingdom, U. S. A., Canada etc. It would perhaps be desirable to describe some of the methods employed in these countries to attract the attention of industrialists and the potential individual who is likely to use and derive the ultimate benefit of research activities. A review of these methods has recently appeared in the British Commonwealth Scientific Office Memo No. 525, (United Kingdom Scientific Mission Memorandum No. 66/47 dated 25th August 1947). The British Commonwealth Scientific Official Conference set up in 1946 a Standing Committee Working Party to determine ways and means of promoting the utilisation of non-patentable scientific and technical data. The Committee contacted various American and Canadian agencies to determine methods in operation in these countries in connection with both patentable and non-patentable discoveries. Of these, the methods found to be most satisfactory and now in general use are briefly outlined below :

The methods employed by the Federal and State Agricultural Colleges (U. S. A.) in interesting farmers and others likely to benefit by the implementation of their results fall into three categories, viz:—

(a) Methods that reach the masses:

News stories, circular letters, radio, cinema, exhibits, bulletins and posters.

(b) Methods that reach groups:

General meetings, demonstration meetings, leader training meetings, extension school and study courses.

(c) Methods that reach individuals:

Demonstrations, farm and house visits, office calls, telephone calls and correspondence.

The Bureau of Agricultural and Industrial Chemistry (U. S. A.) has given much thought to determining the best methods of keeping industry informed and to getting commercial firms to develop the laboratory scale results obtained in its regional laboratories. After several years of experimentation, the Bureau has found that the best results are obtained by one or more of the following five methods:—

- (a) Demonstrations by pilot plants which show to industrialists how the process can be operated on full production basis. It is the Bureau's experience that if this course is not adopted, more often than not the potentially interested industrialist will not take the trouble to give a new process a tryout.
- (b) Frequently the Bureau enters into a cooperative agreement with industry i. e. a firm's plant is used to develop a process worked out on the laboratory scale by the Bureau's staff. To avoid possible jealousy or recrimination from other potential users, the Bureau wherever possible, asks the appropriate industrial trade organisation to nominate the firm with which it enters into a formal or informal collaborative agreement.
- (c) Each regional laboratory has one scientist on its staff who devotes his whole time to liaison work between the Bureau and industry. The liaison officers keep industry informed of the Bureau's activities by personal visits and they also endeavour to determine the nature of industry's problems and utilise the information so gathered in planning future research programmes of the Bureau. Many large firms reciprocate by appointing liaison officers who work in the reverse direction.
- (d) The Bureau tries to get itself represented on as many trade organisations as possible. This has been found to be one of the best means of winning industrial confidence and ensuring interest in the Bureau's research activities.

- (e) The Bureau makes the fullest possible use of publications encouraging its scientists to publish their research findings in a wide variety of recognised scientific journals.

The Department of Commerce (U. S. A.) maintains an office of technical services which publishes abstracts of reports in appropriate weekly technical journals and also what it calls a 'Technical Digest' in the technical press. The Technical Digest is also disseminated to local industry through the departmental field officers. Another method which was tried with every promise of success, but had to be abandoned because of opposition from publishing firms, was to popularise the results of state sponsored research through the medium of an attractive magazine entitled "Federal Science Progress".

The Tennessee Valley Authority conducts research primarily as an incident to a unified regional programme of water control, resources development and national defence. It has applied a novel approach to industrial development, namely the need of mobilising all relevant research activities and to bring them to bear upon problems which individual business men face and also of integrating and interpreting the results of research in such a manner that those concerned can apply them to specific situations. This involves four kinds of activities viz.—

- (a) Assembling information about the kind, quality, quantity and location of specific resources that are available for use by business men.
- (b) Conducting technical and industrial economic research necessary to determine the best alternative way in which these resources can be used.
- (c) Identifying the individuals or groups of individuals who have the incentive, initiative and capacity to apply modern technology in particular businesses related to opportunities revealed by research.
- (d) Working with those individuals or groups to assist them in applying modern technology to the utilisation of resources with profit and at the same time to produce goods and services that can be of maximum benefit to the people as a whole.

The Tennessee Valley Authority works on the assumption that (i) industry and business are responsible for making decisions on how

resources are to be converted into goods and services through the application of technology ; (ii) industrialists and businessmen need a great deal of technical and economic information in order to make their decisions on expanding or reducing existing business or undertaking new enterprises ; (iii) public agencies can and should contribute heavily towards making needed technical and economic information available to business ; and (iv) a new relationship is needed between public and private groups concerned with technological development which recognises the responsibilities of each.

The Canadian National Research Council maintains a Technical Information Service which answers enquiries received through regional representatives or directly from manufacturers, drawing freely on all available sources of information in furnishing the information required. Specific answers to the questions asked are sent in reply to inquiries, wherever possible. T.I.S. has no laboratories of its own but through its connections it has in a number of cases been instrumental in placing manufacturers in touch with research organisations, both federal and provincial, with whom arrangements for actual research have been made under terms agreed upon by the parties directly concerned.

Research Corporation (U. S. A.) is an independent semi-public institution organised to ensure the development of useful inventions and to secure funds from its operation for the support of scientific research in the U. S. A. It exists primarily to develop discoveries of potential industrial value, usually made by university scientists in the course of their independent investigations and consequently of a type which would not normally be developed. As it is able to administer its patents within the U. S. A. only, arrangements are generally made with foreign firms interested in particular American inventions to undertake the custody of their foreign rights.

University Research Foundations are an American development of the past twenty years. The first of these, and the one which has served as a prototype, was the Wisconsin Alumni Research Foundation founded twenty two years ago to administer the Steenbock patents and other patents arising in future out of research work in the University. The Foundation is entirely independent of the University except in so far as its assets revert to the University if it is wound up. The allocation of patentable discoveries to it by the faculty is entirely voluntary, even when the parent research had been financed by funds originally derived from the Foundation. The Foundation plays no part direct or indirect in determining the research

programme of the University, beyond asking that its own funds be confined to research in the natural sciences. Despite its cautious financial policy, the foundation has paid over three million dollars to the University during the past fifteen years and has accumulated a capital endowment of 9 million dollars, starting as it did with a working capital of 900 dollars, plus the Steenbock patent application.

The Purdue Research Foundation, similar in principal and origin to the Wisconsin Foundation is not fundamentally independent of the University or the University of it and its research proposals are submitted for approval to the Foundation and not to an independent university committee.

A comparison of these methods with the procedure prescribed by the Council for the utilisation of its activities will reveal that there is considerable scope for improvement in the steps now being taken to ensure a proper and wider utilisation of the Council's processes. A greater education of the industrialist and the public would appear to be indicated. More and varied publicity including demonstrations and meetings is perhaps necessary. The need for a great liaison between science and industry, unfortunately there is practically none at the moment, is being increasingly felt and steps towards the same should be ensured.

PATENTS

The Council has adopted a liberal policy of patenting its new researches. The object has been twofold: firstly, to encourage the inventive activity of its workers, and secondly, to safeguard the interests of manufacturers seeking to develop the researches on an industrial scale.

The Council has, up to-date, sought patent protection in respect of 104 inventions arising out of its research activities. The inventions are protected in India and in those Indian states which have their separate patent systems. The state patents are taken out mainly in the interest of licensees exploiting Indian patents, and the maintenance of these state patents is in most cases left to the discretion of the licensees. In a few exceptional cases patents have been applied for in the United States and in the United Kingdom.

The patenting activity began in 1940, in which year only two applications for patents were filed. The number increased to 14 original

applications during 1941, when it was found necessary to appoint a full time expert to deal with patent matters. The annual output of inventions was kept up during succeeding years. The figure increased to 21 during 1945 and reached the peak of 27 applications during 1946.

From small beginnings, the patenting activity of the Council has already outstripped that of any other Indian institution, governmental or private. As against the above-mentioned 27 patent applications filed by the Council during 1946, only 12 were filed by Tata Iron & Steel Co., Ltd., which accounted for the second largest number of applications by Indian organizations. In the field of Indian patents, the patenting activity of the Council is already comparable to that of many leading foreign organizations such as International General Electric Co., Inc., Ford Motor Company of Canada, Ltd., and J.R. Geigy A.G. as will be seen from the following list of applications for patents filed during 1946 by different organizations of international standing.

	Names of Organizations	No. of applications contributed during the year 1946.
Foreign.	Standard Telephones & Cables Ltd.	223
	Imperial Chemical Industries Ltd.	84
	General Electric Co., Ltd. ...	65
	E.I. Du Pont de Nemours & Co. ...	60
	Power Jets (Research & Development) Ltd. ...	53
	Metropolitan-Vickers Electrical Co., Ltd. ...	33
	Societe Des Usines Chimiques Rhone-Roullne ...	28
	J.R. Geigy A.G. ...	27
	Ford Motor Company of Canada Ltd. ...	25
	N.V. Phillips Gloelampen Fabricken ...	24
	International General Electric Co. Inc. ...	23
	Indian	Council of Scientific & Industrial Research ...
Tata Iron & Steel Co., Ltd. ...		12

The inventive activity of the Council as shown by the Council patents has attracted a good deal of public interest and admiration. In fact the Council has set the standard for other Indian institutions and inventors as will be seen from the following tributes paid by the Controller of Patents and Designs in a recent address.

"As regards the question whether there is lack of inventive talent in India, there is enough evidence to show that there is no inherent lack of inventive talent in India, either qualitatively or quantitatively. The war-time experience of the Council of Scientific and Industrial Research has shown that given proper incentive and guidance, Indian inventors can rise to the occasion in evolving new processes and products. The Council has, in the course of five or six years, been responsible for over a hundred patentable inventions, and has during the year 1946 alone produced 27 inventions, which is a record number in respect of the annual output or inventions by any single Indian institution".

A full list of processers already patented and awaiting acceptance will be found in the appendix.

It would be reasonable to expect that with the rapidly expanding research activities of the Council, the volume of patent work of the Council would also keep on increasing.

SURVEYS

In connection with its research programmes the Council has found it necessary to undertake a preliminary survey of indigenous resources and allied industries, and a number of such surveys have been initiated by the research committees concerned. So far the Essential Oils Committee, the Internal Combustion Engines Committee, the Radio Research Committee, the Dyestuffs Committee, the Applied Physics Committee and the Electro-Chemical Research Committee have submitted reports on their respective surveys. The other research committees are examining the problem and their reports are awaited.

I. ESSENTIAL OILS COMMITTEE.

The survey of the Essential Oils Industry in India was completed by Messrs. P. R. Narielwala and J. N. Rakshit and published in the year 1942. Their report gives an account of the position of the essential oils industry in India and has suggested various methods and ways by which

this Industry could be developed and placed on firm foundations. These suggestions relate to the undertaking of detailed investigations both botanical and chemical in respect of selected essential oil-bearing plants. As a result of these recommendations, investigations on the cultivations of Rose, Jasmine, Rosa grass and Patchouli have been undertaken.

Further, under the auspices of the Committee a survey of the aromatic plants of India has been conducted. A list of about 420 Indian aromatic plants has been prepared by reference to various sources. The plants have been arranged according to the (i) alphabetical order (ii) botanical classification and (iii) parts of the plant containing aromatic constituents. A list of plants yielding aromatic resins has also been drawn up. Details of individual plants regarding their habitat and botanical characteristics, the parts of the plants yielding essential oil and the yield of essential oil and the physical characteristics, chemical constituents and the uses of the oils are also being compiled. An account of the coniferæ family of aromatic plants consisting of 14 genera and 16 species has been prepared.

A survey of khus root cultivation in India has been conducted in respect of area of cultivation, production, export, uses, possibilities of development and quality. Based on the information thus obtained various lines of improvement of khus industry in India have been suggested.

II. INTERNAL COMBUSTION ENGINES COMMITTEE.

The Internal Combustion Engines Committee has submitted three reports surveying the position relating to the manufacture of internal combustion engines in India and the steps to be taken for further developing the industry so as to make it self-sufficient. The Survey Committee has pointed out that certain types of stationary engines are being manufactured in the country but that there are various difficulties in the way of necessary alloys, tools and the technical personnel for the further development of this industry. As a result of the recommendations of this Committee, a Chair of Applied Mechanics has been established at the Indian Institute of Science, Bangalore and the services of Prof. P. C. Carter have been obtained in this connection.

III. RADIO RESEARCH COMMITTEE.

As a result of the war, a great need was felt for developing the manufacture of radio instruments and components in India. The Radio Research Committee surveyed the present position regarding the manufacture of radio

sets and components in India and submitted a report. As a result of this survey it became apparent that certain firms in India were already producing certain types of radio components and that if they could be released from war work and given the necessary facilities for importing machinery, equipment and material they would be able to manufacture radio sets in the country. The lack of particular quality of kraft paper, tin foil, carbon microphones and loudspeakers of the required standard and valves were some of the drawbacks. The Council subsidised a scheme for the manufacture of condensers and resistances which has since been completed and is awaiting commercial utilisation. Similarly a scheme on loud-speakers has also been completed. Arrangements have been made for importing from America an electron tube making plant for the manufacture of radio valves in the country. The problems connected with the development of the radio industry are since under active consideration.

IV. DYESTUFFS COMMITTEE.

India has to depend almost entirely on imported dyes for which there is an extensive market within the country provided *inter alia* by the textile industry which has already assumed an impressive magnitude. The Dyestuffs Committee accordingly initiated a detailed survey of the position and the preparation of a scheme for the development of certain important dyes in the country, if necessary, in collaboration with foreign manufacturers. In the report a survey has been made of the needs of India in respect of dyestuffs, the raw materials for dyestuffs which are now being manufactured and which are to be established and methods to be adopted for establishing the industry in India. It has been estimated that the country's requirements can be met by about 50 dyestuffs and 46 intermediates which can be manufactured from available sources and the report has made specific suggestions for their development on an inter-related planned basis.

V. APPLIED PHYSICS COMMITTEE.

This Committee appointed a small sub-committee to go into the question of the manufacture of various scientific instruments in India. The sub-committee surveyed the needs for such instruments and facilities available in the country for their manufacture. It has been decided to investigate further into the matter at a joint meeting of the Applied Physics Committee and the Scientific Instruments Panel of the Department of Planning and Development.

VI. ELECTRO-CHEMICAL INDUSTRIES COMMITTEE.

A special grant was placed at the disposal of Dr. D. Swarup of the Benares Hindu University to meet the expenditure of surveying the problems of the electrochemical industry in India. The survey has been completed and Dr. D. Swarup has submitted a detailed report which is now under consideration.

INTELLIGENCE

The industrial mindedness of India is reflected by the growth in the intelligence service which the Council has been called upon to undertake since its inception 7 years ago, a service which continues to grow with time. The war brought in its train scarcity of both raw materials and finished products and led to the establishment of many industries in this country for the manufacture of similar goods or suitable substitutes from local sources. The existing industries also were generally confronted with difficulties arising from the cessation of imports of essential raw materials. These difficulties involved numerous scientific and technological problems on which the guidance of the Director, Scientific and Industrial Research is sought by industrialists and *entrepreneurs* from all parts of the country and the advice is given with all possible expedition. With the termination of war, the inflow of enquiries has been reinforced by requests for advice on prospects of starting new industries and utilisation of byproducts etc., in those industries that are called upon to strengthen their competitive power by reducing the cost of production. Comparatively small capitalists who are desirous of embarking on an industrial career have been evincing a keen interest in understanding the technical and commercial implications of certain promising lines involving small investment and informative notes for their enlightenment are freely supplied from the Council office. Enquiries are also received from time to time from Government departments, Directors of Industries of the Provinces and Indian States on specific technical questions and these are promptly attended to. In some cases the advice of the Director is sought by research workers on particular problems of investigation. These services of the Council are expected to increase by rapid strides with the coming into being of the various National Laboratories and even with the present limited organisation, the Council has to deal with an impressive variety and a large number of enquiries throughout the year, embracing all the categories mentioned above.

An idea of the diverse nature of the enquiries that are received can be gathered from the following list which is only illustrative of the type and

not exhaustive. The number of enquiries is increasing every year and during the year 1946-47 it reached the figure of 1500. This figure is bound to increase further as industries in the country are developed.

1. Radio manufacture in India.
2. Manufacture of soap.
3. Manufacture of penicillin.
4. Manufacture of agar-agar.
5. Manufacture of pastel drawing chalks.
6. Manufacture of plastics and plastic moulding materials.
7. Manufacture of activated carbon.
8. Manufacture of carbon electrodes.
9. Manufacture of cellulose and its derivatives.
10. Manufacture of nicotine and its bye-products from tobacco waste.
11. Manufacture of barium chloride.
12. Commercial development of glass wool in the country.
13. Utilisation of bauxite (red mud).
14. Manufacture of weed killers.
15. Manufacture of gelatine and glue.
16. Manufacture of superphosphates.
17. Manufacture of animal charcoal from raw bones.
18. Manufacture of casein plastics.
19. Manufacture of celluloid.
20. Manufacture of ebonite rods and tubes.
21. Utilisation of paddy husk.
22. Manufacture of fountain pens and parts thereof.
23. Manufacture of acetate rayon.
24. Manufacture of resins, natural and synthetic.
25. Manufacture of paints and pigments.
26. Utilisation of felspar.
27. Manufacture of boot polish.
28. Utilisation of gypsum.
29. Uses of oils, vegetable and mineral.
30. Manufacture of sugar and syrups.
31. Therapeutical value of *mritesanjibani*.
32. Acids of all sorts including mineral acids.
33. Radium.
34. Dry cell manufacture.
35. Manufacture of lime from lime stone.

36. Glass industries.
37. Introduction of clock manufacture in India.
38. Manufacture of suitable vessels for chemical industry.
39. Collection of information regarding charcoal and firewood for the International Executive Council World Power Conference, London.
40. Manufacture of pencils.
41. Aluminium industry.
42. Manufacture of cement from limestone.
43. Paper industry.
44. Shellac.
45. Film industry.
46. Caffein from tea waste.
47. Production of cheap electric current.
48. Hides and their curing.
49. Production of soya beans.
50. Manufacture of liquid gold.
51. Synthetic detergents.
52. Manufacture of rubber products.
53. Manufacture of sodium azide.
54. Utilization of various kinds of sands.
55. Baluchistan sulphur.

In dealing with these enquiries, the Director, Scientific and Industrial Research is assisted by the Industrial Economic Assistant Secretary (Technical) and two technical assistants.

Another type of intelligence work which the Council has recently started is the Scientific Information Service. The Council receives from different sources, such as the British Commonwealth Scientific Office, atomic scientists, foreign universities, research institutes, government departments, etc., a variety of scientific literature in the form of notes, papers, pamphlets. The Scientific Information Service has been inaugurated with a view to sharing the information so received with other Indian scientists and Indian scientific organisations. All useful information received is abstracted, special attention being paid to literature dealing with such subjects as chemistry, physics, glass, ceramics, metallurgy, fuels, building material etc., problems on which are being worked or are expected to be worked in the laboratories of the Council and in the National laboratories being built under the aegis of the Council. The work of abstracting was

started only recently and during this short period about 50 abstracts have been prepared and issued. These abstracts are being at the present moment, serially numbered but it is expected that a better system of classification will be adopted shortly. This service has only a limited circulation at the moment being confined to the Chairmen of the different research committees of the Council of Scientific and Industrial Research, Directors and Assistant Directors of the Research Laboratories, Editor of the Journal of Scientific and Industrial Research and others interested. It is, however, hoped that an increase in circulation so as to include the various Indian university libraries, Provincial and Central Research Institutes and scientific magazines, will be effected at an early date.

The Scientific Information Service is at present being conducted under the personal supervision of the Director, Scientific and Industrial Research who is assisted in this work by a Junior Technical Officer.

JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

This official organ of the Council was started as a quarterly publication in July 1942, with the objects of providing a technical news service and of providing a medium for the publication of research papers of scientific and industrial importance. The following members constituted the editorial board at the time of the inauguration of the journal :

1. Sir S.S. Bhatnagar	Chairman
2. Sir J.C. Gosh	Member
3. Dr. Nazir Ahmad	"
4. Sir K.S. Krishnan	"
5. Dr. Jivraj Mehta	"
6. Dr. Mata Prasad	"
7. Dr. S. Krishna	"
8. Dr. B.L. Manjunath	"
9. Mr. T.S. Pillay	"
10. Mr. J.N. Sen-Gupta	"
11. Prof. M.N. Saha	"
12. Mr. B.N. Sastri	Secretary

The first number appeared in October 1942, and was received warmly by scientists and industrialists both in India and in foreign countries. The reviews appearing in foreign technical journals were highly complimentary and several articles appearing in the Journal were reproduced in foreign

periodicals. It was soon realized that for furthering the objects of the Journal, and to cope with the increasing volume of publishable material that became available, both the size and frequency of the Journal should be increased. At a meeting of the Editorial Board held at Bangalore on 28-11-1943, the important decision to issue the Journal as a monthly publication was taken. It was also decided to organize a library of exchange publications to facilitate the abstracting and other aspects of the work of the Journal.

The first monthly Journal was issued in April 1944, and the progress of the Journal has been continuously upward since then.

Table I gives the growth of the Journal by Volumes :

Table I.

<i>Volume No.</i>	<i>Year</i>	<i>No. of pages.</i>
1	1942-43	383
2	1943-44	318
3	1944-45	602
4	1945-46	790
5 (6 months July-Dec.)	1946	304 + 84 = 388
6	1947	508 + 192 = 700

The growth in the circulation of the Journal is given in Table II. The figures refer to the number of copies distributed as on 31st March of the year.

Table II. *Journal Distribution.*

<i>Years</i>	<i>Circulation</i>
1943	780
1944	930
1945	1128
1946	1472
1947	1532

There has been an increasing pressure on advertisement space in the Journal. At an early stage of the Journal the Editorial Board decided that a selection should be made among the advertisements received for publication in the Journal. At the meeting held in September 1946, the Editorial

Board fixed the maximum number of advertisement pages as one-third of the number of text pages. Table III gives the number of pages of advertisement appearing in the March number of the Journal in each year.

Table III. Advertisement pages.

<i>Year</i>	<i>No. of pages.</i>
1943	13
1944	13
1945	30
1946	29
1947	31

There has been an increasing demand for exchanges, and for the free supply of copies to public institutions. In accepting exchanges, the standard of the Journal offered in exchange and its usefulness are taken as the criteria. Table IV gives the number of Journals received in exchange for the Journal year-wise.

Table IV. Exchanges.

<i>Year</i>	<i>Foreign</i>	<i>Inland</i>	<i>Total</i>
1945	20	33	53
1946	45	43	88
1947	61	45	106

The Editorial Board now consists of the following members :

1. Sir S.S. Bhatnagar	Chairman.
2. Dr. H.J. Bhabha, Bombay	Member
3. Sir J.C. Ghosh, New Delhi	"
4. Dr. Jivaraj Mehta, New Delhi	"
5. Dr. S. Krishna, Dehra Dun	"
6. Sir K.S. Krishnan, Delhi	"
7. Dr. B.L. Manjunath, New Delhi	"
8. Prof. Mata Prasad, Bombay	"
9. Sir C.V. Raman, Bangalore	"
10. Prof. M.N. Saha, Calcutta	"
11. Mr. D.N. Wadia, New Delhi	"
12. B.F. H.B. Tybji or one representative of the Department.	"
13. Mr. B.N. Sastri	(Secretary).

The tabulated statements give an indication of the progress the journal has been steadily making since its inception. The journal has been receiving increasing recognition in India. Advice has been sought by editors of other journals for improving the format of existing journals or for starting new ones. Enquiries on such matters have been received from the Editor of I.C.A.R. publications, Imperial Records Department, Forest Research Institute, Central Board of Irrigation and Haffkine Institute.

The destiny of the journal has never been in doubt. With 24 active Research Committees of the Council, 7 National Research Laboratories, a large number of surveys sponsored by the research committees, important developments in research utilization and other progressive measures taken on hand by the ever-expanding Council of Scientific and Industrial Research, there can be no doubt as to the scope for its further expansion.

Besides the non-technical notes of the utilization branch, the Journal has provided a medium for the publication of articles from the Dictionary of Economic Products, Survey of Aromatic Plants sponsored by the Essential Oils Committee and Atmospheric Data of the Radio Research Committee. There has been a growing pressure on our space, and further expansion would have been achieved by now, had it not been for the difficulties of printing and paper. As the chairman said at one of the meetings (8-3-1945), the real limitation for making more rapid progress has been the shortage of good quality printing paper and adequate printing facilities. More recently these difficulties have become more acute, and they have been further accentuated by labour troubles in the press and communal disturbances. There has been no lack of effort to overcome the difficulties and there is every reason to feel confident that the progress in the near future will be even more rapid than it has been during the past 5 years.

THE DICTIONARY OF ECONOMIC PRODUCTS AND INDUSTRIAL RESOURCES OF INDIA

More than 50 years have elapsed since Watt completed his monumental work on the Economic Products of India. This was "an approximately complete resume of the opinions of Indian authors and extensive official and private enquiries regarding the economic products of India." The aim was to advance the material interests of India by bringing the

trade and capital of the west into more direct contact with the resources of the Indian empire. His work was mainly a guide to the industrial *entrepreneur*, an aid to the administrator and student of Indian economic conditions. The time-limit set upon his work precluded original and personal investigation of critical questions. Watt himself was aware of these severe limitations. In his preface, he has suggested that a revision of his work will be necessary to remedy some of these defects.

The period since the publication of Watt's work has been one of rapid changes in India. From a purely agricultural country, India has suddenly become a semi-industrialised state. The tempo of this change has quickened of late. The World War II has given an added impetus to her indigenous industries. Moreover, scientific advance has been responsible for the acquisition of a vast amount of new knowledge all over the country. But this body of information published in journals, memoirs and reports is not easily accessible.

Taking all these facts into consideration, the Governing Body of the Council of Scientific and Industrial Research in April, 1942, accepted the recommendations of the sub-committee of the Board for the compilation of a Dictionary of Raw Materials of India, on lines similar to those of Watt's Dictionary of Economic Products, and in August, 1942, appointed a Chief Editor and 3 Assistant Editors. The President of the Council of Scientific and Industrial Research was pleased to appoint an Advisory Board on 8th December 1942.

With a view to make its scope more comprehensive, the Advisory Board changed the title of the work to "Dictionary of Economic Products and Industrial Resources of India". A small Editorial Committee was also constituted, which issued detailed instructions to the staff and directed that the resources of the whole of the Indian Empire as well as those of Burma and Ceylon should be surveyed.

The Editorial Committee also appointed several sub-committees of experts for assisting the work of the following sections of the Dictionary:

(1) Cultivated & Medicinal Plants, (2) Forest Flora, (3) Animal Products, (4) Minerals, (5) Chemicals, (6) Industries & Industrial Resources, and (7) Economics and Statistics.

The new Dictionary which is being compiled is not merely a revision of Watt's work. It is the very immense task of presenting a complete

resume of all available information about the raw materials of India. The sections on animal products and mineral resources will contain much more elaborate information than in Watt's work. Moreover, since the country has undergone a complete change in the direction of industrialization, all raw materials useful for Indian industries have been included. A complete survey of the present position of the various Indian industries forms a new feature. Thus it may be claimed that this Dictionary is an entirely new and original work.

The ledgers which had been carefully preserved by Watt and his assistants in his time had been distributed to various institutions. Some of these ledgers are not traceable. Others have not been kept up-to-date. The result is a *de novo* effort where all the information on every subject has to be collected anew and properly assessed. In the early period of this scheme it was expected that specialists would be invited to contribute the major articles for the Dictionary, and that the work of the staff would be mainly that of editing these articles and filling any gaps in order to make them comprehensive, and of compiling articles on minor subjects. In consultation with the various sub-committees, lists of the more important items to be included in the Dictionary were prepared and a large number of invitations for contributions were sent throughout India to various institutions and individuals with expert knowledge. The articles compiled were to be given preliminary publication in current journals and suggestions received made use of when preparing the final drafts of the text. The response, however, was not encouraging because of the disturbed conditions and heavy pressure of work due to the war. Consequently it became necessary to revise the procedure and to start the work of compilation from the beginning. To cope with the increased work an increase in the staff was necessary and the Editorial Committee sanctioned an additional Assistant Editor in Botany and a number of technical assistants to carry out the work.

It has, however, been possible to enlist the co-operation of several colleagues in different provinces to act as regional correspondents.

During the five years since the scheme was started, it has been possible to complete the first volume (comprising articles beginning with letters A and B) and proceed with the compilation of the second volume.

The printing of the first volume of the dictionary has been considerably delayed because of the delays involved in negotiating publication terms

with Messrs. Kitabistan, who it was originally intended would print and publish the first volume. As the terms offered by them were unacceptable, the printing has been entrusted to the Government of India Press, New Delhi, and the Manager of Publications, New Delhi has agreed to publish the work. It is expected that the first volume will be published early in 1948.

The Editorial Committee decided that the Dictionary should be illustrated with photographs, maps, charts and graphs. Although the post of an Artist was sanctioned in June 1945, it was only in March 1947 that the Chief Editor has been able to obtain his services.

The Chief Editor has been able to obtain a large number of botanical illustrations of a very high quality through the courtesy of the Superintendent of the Horticultural Gardens at Bangalore. Other figures, maps and charts are being got ready through the help of the Administrative Intelligence Room. In this connection thanks are due to Major P. W. Homfrey, Director of the Administrative Intelligence Room, who has not only readily taken up this work but has also promised to get the blocks prepared and the illustrations printed through the Eagle Lithograph Press, Calcutta. Thanks are also due to the Marketing Department, the Forest Research Institute and other institutions, and gentlemen who have readily responded to our request for specimens and illustrations.

WORK OF SECTIONS:

An idea of the work involved in each section will be possible from the statement below:

Statement showing the Total Number of Articles to be included in the Dictionary and the Distribution of Work

Section	Total No.	No. of articles in the 1st vol.	No. of articles in the 2nd vol. (A & B)	No. of articles received from external contributors.
Botany.	3,500	210	328	43
Zoology.	47	7	8	36
Minerology.	100	14	10	45
Chemistry & Industry.	264	45	41	(49+51) 100

BOTANY SECTION.

This is the largest section in the Dictionary comprising over 3,500 articles on plants, classified for convenience of treatment into 3 groups, (1) Cultivated Plants, (2) Forest Plants, and (3) Medicinal Plants.

In the case of cultivated plants it has been possible to get the co-operation of a fair number of specialists on the major crops. The task of editing these and the rest of the work is being carried out in the office. The Chief Editor is grateful to the Marketing Office for their help at every stage in this work and to the Director of the Indian Agricultural Research Institute for affording library facilities to the staff.

With regards to the forest flora, the Editorial Committee at first decided to entrust the work to the Forest Research Institute but on going into details, besides other considerations it was found that this would involve considerable delay and it was consequently decided to have the work carried out under the direct auspices of the Council. Similarly although it was intended to have the articles on medicinal plants compiled by Col. Sir R.N. Chopra it was later on considered necessary that these should also be taken up under the direct supervision of the Chief Editor. These factors and frequent change of personnel has been responsible for considerable delay in the progress of work in this section.

ANIMAL PRODUCTS SECTIONS.

This section has suffered greatly through the non-availability of suitable candidates for the post of Assistant Editor, Zoology. The Editorial Committee decided in August 1945 to entrust the work in the section to Prof. C.R. Narayan Rao on an honorarium of Rs. 300/- but after completing half the work Prof. Narayan Rao suddenly resigned in December 1946. The technical assistant working with him also left. The present staff is trying to do its best to cope with the work.

MINERALS SECTION.

The Editorial Committee was anxious to have the cooperation of the Geological Survey of India in connection with work of this section. But as Sir Cyril S. Fox was able to obtain a special grant for publishing a book on "Mineral Resources of India," at one time it looked as if the desired cooperation would not be forthcoming. The position, however, has considerably improved of late and subsequent Directors of the Geological

Survey have been extremely helpful. Out of a total of 100 subjects in this section about half have been contributed by the Geological Survey while the rest have been compiled by the Dictionary staff and revised by the Geological Survey. 6 articles on different subjects are at the moment expected from external contributors.

It was originally intended to publish a separate volume on minerals but it has now been decided to incorporate the articles in the alphabetical order in the main dictionary.

INDUSTRIES AND CHEMICALS SECTION:

The section on 'Industrial Products' has greatly expanded the scope of the Dictionary and given it a new orientation. The work has presented peculiar difficulties because of the absence of any published information on several subjects and also the unwillingness of industrial concerns to part with any information. In many instances the Assistant Editor-in-charge has to visit various industrial centres and draft the articles from the information gathered, after sifting the data collected. This procedure causes unavoidable delay in the progress of the work. The Chief Editor is thankful to the few industrial concerns who have contributed some extremely valuable articles.

In the case of 'Chemicals' most of the information has been gathered in the ledgers and the articles are being finalised in the order of publication.

WORK IN PROGRESS.

The Dictionary office is now proceeding with the compilation of articles for the second volume, and the building up of ledgers for the remaining volumes. At the time the scheme was started, there were only a Chief Editor and 3 Assistant Editors. Later, at various stages, the necessary technical staff was sanctioned. But there has been very great difficulty in recruiting permanent people for the office. Since the office is purely temporary and renewed year after year people look upon this office more or less as a jumping ground for other posts.

NATIONAL LABORATORIES

"The establishment, maintenance and management of laboratories, workshops, institutes and organisations to further scientific and industrial research" was considered as one of the fundamental aims when the Council of Scientific and Industrial Research was created. With the setting up of the Board of Scientific and Industrial Research in 1941, the laboratories of the Industrial Research Bureau were placed under the direct charge of the Director, Scientific and Industrial Research. At the very outset it was realised that facilities offered by these laboratories were far from adequate and would have to be immensely augmented to meet the ever growing needs and demands of a country like India which had come to occupy a large and prominent position in the industrial world.

From the organizational point of view the first few years of inauguration of the Council have marked a forced prolongation, on account of the prevailing conditions of war, of what may be called the experimental stage of research development in India originally initiated by the Industrial Research Bureau. Although the war has provided an effective stimulus to the activities of the Council which have steadily increased even within the limited facilities available, the initiation of a comprehensive and costly expansion schemes was hitherto precluded by the difficulties entailed by the war itself in the matter of obtaining suitable laboratory equipment, services of foreign experts, etc. Even so, it was realised at the very outset, that the machinery available for scientific and industrial research in India was very inadequate and that for tackling research problems bearing on Indian resources and industries for development purposes, a much larger organisation comprising some essential laboratories at a substantial cost, of both capital and recurring expenditure, would have to be set up. The initial experience during the war period had, indeed, proved useful in throwing the gaps in the present organisation into a bold relief and focussing public attention on the necessity of expanding available facilities of research as an important national problem.

Steps had, accordingly, been taken to give a concrete shape to the idea of needed expansions as an anticipatory measure to be implemented immediately on the termination of hostilities, and certain tentative proposals and schemes drawn up by the Director, Scientific and Industrial Research even at the very inception of the Council, for five national laboratories, viz., a National Chemical Laboratory, a National Physical Laboratory, a National Metallurgical Laboratory, a Central Fuel Research Station and a Glass and

Ceramic Research Institute were approved, in principle, by the Government of India. The Government of India announced in 1944 a capital grant of Rs. 1 crore for the establishment of these laboratories to be drawn upon immediately, if necessary, for the Glass and Fuel Institutes and planning up to Rs. 10 lakhs, and on the termination of the war for the rest of them. The public too evinced keen interest in the Council's schemes and some industrialists offered handsome donations toward their cost. The House of Tatas donated Rs. 20 lakhs for the establishment of a National Chemical Laboratory (Rs. 8.30 lakhs) and a National Metallurgical Laboratory (Rs. 11.70 lakhs). Messrs. Indian Steel & Wire Products Ltd., donated a sum of Rs. 1 lakh. The late Mr. D.P. Khaitan and the Indian Metallurgical Association donated Rs. 25,000 and Rs. 10,000 respectively, the latter being since earmarked by the Council for the National Metallurgical Laboratory. The Central Government allotted 66 acres of land in Delhi for the construction of the National Physical Laboratory. The Raja of Jharia has made a gift of 100 acres of land at Dhanbad as the site for the proposed Fuel Research Station. For preparing plans of each of these laboratories a committee of experts had been appointed by the Council, and for most of them detailed plans, designs and estimates have been formulated.

Details of the progress made in connection with the following National laboratories are given in the pages that follow :—

1. National Chemical Laboratory.
2. National Physical Laboratory.
3. National Metallurgical Laboratory.
4. National Fuel Research Institute.
5. Central Glass and Ceramics Research Institute.
6. Road Research Institute.
7. Building Research Institute.

Amongst others to be included in the chain of National laboratories in the near future are :—

1. Central Drug Research Laboratory.
2. Food Research Laboratory.
3. Leather Research Institute.
4. Electro-Chemical Industries Research Laboratory.

National Chemical Laboratory, Poona.

The need for the establishment of a National Chemical Laboratory and a National Physical Laboratory was felt soon after the appointment of the Director, Scientific and Industrial Research in 1940. Proposals for these were first made by the Director in 1941 and were readily accepted by the Hon'ble Sir A. Ramaswami Mudaliar, the then Commerce Member of the Government of India and President of the Board of Scientific and Industrial Research. In his preliminary note the Director had pointed out the necessity of having a properly constituted Planning Committee to draw up the detailed plan of the National Chemical Laboratory and examine the question of site, equipment, staff, finance etc. A Planning Committee for the National Chemical Laboratory under the chairmanship of Sir Ardeshir Dalal was set up in July 1943 by the Governing Body of the Council of Scientific and Industrial Research, following a recommendation by the Board of Scientific and Industrial Research.

This committee drew up a tentative scheme which was circulated to a large number of scientific organisations and individuals for comments and suggestions. A whole time Assistant Director (Planning) was appointed to assist the Committee and act as a secretary shortly after. Following largely on the lines of the National laboratories in other countries and taking into consideration the special needs of India, the committee has worked out a detailed plan for the National Chemical Laboratory.

The work of the National Chemical Laboratory would be largely of a fundamental, basic and applied character along lines likely to promote research in industrial chemistry and the chemical utilization of the raw material resources so as to help the industrial development of the country. The development of new processes evolved at the National Chemical Laboratory will, wherever considered desirable, be carried out upto the pilot plant stage so that the chemical and other industries requiring the aid of chemical research in general will benefit from the investigations carried out at the laboratory. In India facilities up to the pilot plant stage are rarely available and much of the scientific research which has been carried out so far, has not been so convincing to industrialists and would-be manufacturers as it might have been if the success of a process had been demonstrated on a semi-commercial scale. The National Chemical Laboratory will be able to initiate ambitious investigations involving large expenditure of funds and materials and will maintain the closest co operation with existing institutions and with industry.

The work of the National Chemical Laboratory will be divided into seven main divisions: 1. Division of Inorganic Chemistry including Analytical Chemistry. 2. Division of Physical Chemistry including Electrochemistry, 3. Division of the Chemistry of High Polymers. 4. Division of Organic Chemistry. 5. Division of Biochemistry including Biological Evaluation. 6. Division of Chemical Engineering. 7. Division of Surveys and Intelligence.

The scientific staff of the laboratory will consist of a Director, Heads of Divisions, Research Officers and Research Assistants totalling about 115. In addition to these the administrative and ministerial personnel will number 42 while the strength of the technical staff for workshop and other services will be 35. The Director will be provided the assistance of an 'Advisory Board' consisting of eminent scientists and industrialists of the country who will help him in matters of general policy and the general research programme of the laboratory. For the co-ordination of internal work he will be assisted by a 'Committee of Research Co-ordination' consisting of all the Heads of different divisions of a laboratory. The Committee will chalk out the details of the programme of research work and examine from time to time the progress and future plan of work. It will help to co-ordinate the work of each division, and prevent their becoming in any way watertight units. In view of the fact that for several fields of investigations properly trained personnel may not be available it has been considered necessary to select suitable persons and then send them for training to proper institutions abroad. In addition to the permanent staff of the laboratory provision will be made for research fellowships and research studentships in each division of the laboratory. Research fellowships play an important role in all similar institutions in the world. Both in the fields of pure and applied research, research fellowships will be of great value. Provision will also exist in the laboratory for a number of post-graduate students who want training and experience in any field of work in which the laboratory is interested. These students after their training will provide the scientific and technical personnel to industry, to industrial research laboratories and to scientific institutions.

Poona which enjoys a moderate climate all the year round, and is within easy reach of Bombay and her industries has been selected for the location of the laboratory. A site of 430 acres on a beautiful and healthy plateau and in close proximity to educational institutions of the town, has been selected for the laboratory on the Pashan Road.

The buildings of the National Chemical Laboratory as proposed will consist of a large imposing main building, and a few small separate buildings for certain specific purposes. The main building will house the Director's office and his administrative staff, offices, small and special laboratory units and general laboratory halls for each division, library, lecture hall and lecture rooms, a common room and refectory and stores. The other buildings will provide accommodation for pilot plants, workshop, boilers, gas plant, stores for coal and inflammable substances; animal house, garage and poison gas sheds. The design of the buildings will be on a unit plan similar to those of modern laboratory buildings in U.S.A. and U.K. which allows for any amount of expansion to meet future needs. It will incorporate modern fittings, internal telephone system, acid proof floors and air conditioning, wherever necessary. It is estimated that the laboratory will cover a floor area of about 1,80,000 sq. ft.

The construction and equipping of the laboratories has been estimated to cost about Rs. 33.5 lakhs; the maintenance about Rs. 9.53 lakhs in the first year, increasing by Rs. 51,000 per year in subsequent years. The Governing Body of the Council of Scientific and Industrial Research has agreed to amalgamate the chemical section of the laboratory at present administered by the Director, Scientific and Industrial Research, with the proposed National Chemical Laboratory. The value of equipment, chemicals, apparatus and the library of this laboratory has been estimated at Rs. 5.6 lakhs at pre-war rates. Rs. 25 lakhs has been allocated for the National Chemical Laboratory out of the one-crore of rupees donated by the Central Government. The Tata organisation has donated Rs. 8.3 lakhs for this laboratory. The National Chemical Laboratory has, therefore, now available a total sum of Rs. 38.9 lakhs in the form of cash and equipment.

The site selected by the Planning Committee for the National Chemical Laboratory at Pashan Road, Poona was in the possession of the Defence Department and although steps to acquire the same were initiated at an early stage, there have been innumerable difficulties and the Council has not yet come into the full possession of the land. Considerable delay in acquisition was caused by the objection raised at one time by the Government of Bombay about the undesirability of having a chemical laboratory in close proximity of the Government House, Poona, but ultimately a notification acquiring the site was published in the Bombay Government Gazette of 19th December 1946.

Being in possession of a greater part of the land, the Defence Department showed considerable reluctance to release it and it was only through the result of the personal efforts of Hon'ble Shri C. Rajagopalachari, then President of the Council, Director, Scientific and Industrial Research and the Hon'able Sardar Baldev Singh, Defence Member, Government of India, that the Defence Department promised to release the land by the end of March 1947.

The foundation stone of the National Chemical Laboratory was laid on 6th April 1947 by the Hon'ble Shri B. G. Kher, Prime Minister, Bombay before a large and distinguished gathering presided over by the Hon'ble Shri C. Rajagopalachari, the then Member for Industry and Supply, and President of the Council. But there were several hurdles of inter-government de-requisitioning etc. to be crossed before the Council could come into formal possession of the land. Most of the difficulties have now been overcome and construction has started.

While these difficulties about the acquisition of the land were being overcome, the Planning Committee and the Local Advisory Committee have been engaged in drawing up detailed plans for the building of the laboratory. These plans have been finalised and at their meeting held on the 2nd August 1947, the Planning Committee decided that in view of the limited funds at the disposal of the Council for the building of the National Chemical Laboratory, tenders be in the first instance invited for the (i) foundation, the basement and the plinth of the entire building; and (ii) ground and first floor of the front block 636-feet in length. The intention at the moment is to build up the three wings of the laboratory up to plinth level only and to leave the second floor of the front block to be built later on.

Tenders for the construction of this work were received and opened on the 8th October 1947. These have been scrutinised and the lowest tender has been accepted. It is expected that the construction will be completed by April 1949, if there are no unforeseen difficulties in obtaining the construction material.

Along with the building, steps have been taken to provide gas, water and electricity and it is hoped that arrangement for the supply of these essential services will also be completed almost simultaneously with the completion of the buildings.

To overcome the acute accommodation problem in Poona and the distance of the laboratory from the town, the Local Advisory Committee and the Planning Committee have emphasised the urgent need of giving high priority to the question of constructing staff quarters. These views have been accepted by the Governing Body of the Council and the Ministry of Works, Mines and Power have been requested to arrange and build the required staff quarters from the budget of the Central Public Works Department as had been agreed to in the case of the National Metallurgical Laboratory and the National Fuel Research Institute.

The Planning Committee of the National Chemical Laboratory, Poona, is composed of the following 7 members.

Sir. J.C. Ghosh	Chairman
Sir S.S. Bhatnagar	Member
Prof. J. N. Mukherjee	"
Dr. K. Venkataraman	"
Dr. M.D. Parekh	"
Prof. M.D. Qureshi	"
Dr. B.D. Laroia	Secretary

The Local Advisory Committee has the following 8 members.

Principal D.G. Karve	Chairman
Mr. P.A. Narielwala	Member
Mr. A.A. J. Bain	"
Principal D.D. Karve	"
Principal G.R. Pranjpe	"
Principal J.A. Tarporewala	"
Dr. Jivraj N. Mehta	"
Dr. B.D. Laroia	Secretary.

National Physical Laboratory.

The idea regarding the establishment of a National Physical Laboratory for India was brought to a head by a motion at the meeting of the Governing Body of the Council of Scientific and Industrial Research held at Bombay on 3rd February 1943. At this meeting the Governing Body decided to set up Committees for the purpose of drawing up plans and estimates for the National Physical Laboratory and other laboratories.

The following Planning Committee was appointed by the Council (with some of the members added at a later stage) for the purpose of preparing detailed plans and estimates for a National Physical Laboratory :

Mr. Ghulam Mohammad, C.I.E.	Chairman
Sir S.S. Bhatnagar, F.R.S.	Member
Dr. Nazir Ahmad, O.B.E.	”
Prof. Meghnad Saha, F.R.S.	”
Sir K. S. Krishnan, F.R.S.	”
Principal G.R. Paranjpe, I.E.S.	”
Dr. H.J. Bhabha, F.R.S.	”
Dr. Wali Mohammed	”
Dr. D M. Bose	”
Dr. Rafi Mohammad Chaudhuri	”
Mr. N.N. Sen Gupta	”
Dr. K.N. Mathur	Secretary

The Committee prepared a tentative plan for the establishment of a National Physical Laboratory in India, copies of which were circulated to well-known scientists and scientific institutions in India and abroad to invite comments and suggestions. Three members of the Planning Committee, who were also members of the Scientific Mission to U.K. and U.S.A. held an informal conference in England in November 1944 with Sir Charles Darwin, the Director of the National Physical Laboratory, Teddington and some of his staff and discussed in detail the proposals made by the Planning Committee. Valuable suggestions were received also from Dr. Robert A. Milliken, President, California Institute of Technology and Dr. Lyman Briggs, Director, National Bureau of Standards, Washington.

In the light of the suggestions and comments received on their tentative proposals, the Committee drew up final plans for the National Physical Laboratory. The Committee's Report was published under the title "Plan for a National Physical Laboratory for India" in February 1946.

According to the Committee's recommendations, the essential functions of the proposed National Physical Laboratory will be :

- (a) Maintenance of and research on fundamental and derived standards.

- (b) Research on industrial standards, viz.,
 - (i) Standards of quality.
 - (ii) Standards of Performance.
 - (iii) Standards of Practice.
- (c) Investigations on raw materials for industries.
- (d) Standardisation of raw materials, processes and finished goods.
- (e) Research on processes.
- (f) Framing of and advice on specifications.
- (g) Scientific and industrial testing.
- (h) Publications.

The laboratory will comprise of the following divisions :—

- (1) Weights and Measures.
- (2) Applied Mechanics and Materials.
- (3) Heat and Power.
- (4) Optics.
- (5) Electricity.
- (6) Electronics and Sound.
- (7) Building and Housing Research.
- (8) Hydraulics Research.
- (9) Analytical Chemistry.

In addition to the above divisions, the laboratory will have the following important sections of work for which adequate provision has been recommended in the Committee's report :

- (a) Central library with a section dealing with research information.
- (b) Central workshop, including glass blowing and working shops.
- (c) General administration.

One of the most important functions of the National Physical Laboratory will be the maintenance of primary standards of all kinds and also the carrying out of investigations on the improvement of sub-standards and working standards in all fields. The existing Government Test House at Calcutta and the test houses that may be established in future, will engage only in commercial and contractual testing work for which facilities may be extended to keep pace with the industrial development of the

country. The test houses are recommended to function as units under the direction of the National Physical Laboratory. Those problems connected with commercial testing which involve research work will be referred by the test houses to the National Physical Laboratory.

The National Physical Laboratory will undertake research, which may broadly fall in the following three categories :—

- (i) Research on Standards.
- (ii) Research in Applied Physics.
- (iii) Fundamental Scientific Research.

Research on the maintenance and improvement of standards will form the basic responsibility of the laboratory. Every section of the laboratory will have some standards to maintain and as such will be responsible for continuous research in order to effect improvement.

Research in applied physics will be (a) to discover new products, new processes or new uses for raw materials, and (b) to increase the efficiency of existing practice so as to lower costs.

Regarding fundamental research, while the laboratory will be left free to undertake any such research arising out of specific problems with which it has to deal, its main work will be concentrated on applied research.

The question of the location of laboratory was carefully weighed by the Committee. Considered from various points of view, namely, proximity to several large academic centres and industrial towns, and being the headquarters of a number of important government departments like the Meteorological Department, the Agricultural Department, the Medical Department, the Royal Air Force, the General Headquarters, the All-India Radio, the Railway Board, etc., and the seat of the Central Government, Delhi has been selected as the proper place for the location of the National Physical Laboratory. A piece of land measuring 66 acres located near the Imperial Agricultural Research Institute, has been made available for the purpose by the Government of India, free of cost.

The Laboratory will have for its Director an outstanding scientist with experience of administration and research. He will be assisted by an Advisory Board, which will be representative of all interests including the government departments. The scientific staff of the laboratory is

expected to be 90, the technical staff 95 and the library and ministerial staff about 38.

It is recommended that the laboratory should be designed on the best modern lines. All the fittings and services which go to improve and facilitate work are to be incorporated. The design of the laboratory is to be such that adequate provision is made for future extension. A large and well equipped central workshop which will be capable of turning out both large and small work and especially instruments of precision will be attached to the laboratory. In addition, special buildings needed for pilot plant experiments, which will constitute a very important feature of the National Physical Laboratory, will be built.

The laboratory is recommended to be fully air-conditioned. This is intended to protect the delicate instruments from dust during summer and excessive moisture during the monsoons, besides maintaining constancy of temperature so essential for work of standardisation. Air conditioning, it is expected will also increase the efficiency of the workers.

The laboratory is estimated to cover a total floor area of about 2,25,000 sq. feet. The capital cost of the laboratory at Delhi is expected to be Rs. 40.15 lakhs calculated on the basis of 1944-45 prices. The recurring expenditure is expected to be approximately Rs. 7 lakhs in the first year increasing to Rs. 8.5 lakhs in the fifth year. An addition "development grant" of Rs.3 lakhs is also recommended. Against this it is expected that an income of about Rs. 3 to 4 lakhs will be derived from testing fees, research grants, royalties, consultation and technical advice etc., in course of time.

Messrs. Master, Sathe & Bhuta, Chartered Architects of Bombay have been appointed architects for designing the laboratory buildings and blue prints have been prepared by them in consultation with Dr. K.N. Mathur, Assistant Director for planning the laboratory.

The foundation-stone of the laboratory was laid by the Hon'ble Pandit Jawaharlal Nehru, Prime Minister of India on the 4th January 1947. A large number of foreign delegates including Sir Charles Darwin were present on the occasion.

Prof. Sir K.S. Krishnan, F.R.S., University Professor of Physics at Allahabad was selected for appointment as the first Director of the National Physical Laboratory. Sir K.S. Krishnan joined as Director in May 1947.

A Local Advisory Committee to supervise the construction of the Laboratory was set up by the Hon'ble President of the Council of Scientific and Industrial Research in February 1947. The Committee consists of the following :—

1. Director, Scientific and Industrial Research.	Chairman.
2. Rai Bahadur M.S. Mathur, C.I.E.	Member
3. Sir Arthur Dean	"
4. Mr. M.S. Randhawa, I.C.S.	"
5. Prof. D.S. Kothari	"
6. Sir Shri Ram	"
7. Sir K.S. Krishnan, F.R.S.	"
8. Dr. K.N. Mathur	Secretary.

Tenders for the construction of the administrative block were invited by the Council in July 1947. The tender of Messrs. Northern Construction Co., New Delhi, which was the lowest, was accepted on the advice of the Local Advisory Committee of the National Physical Laboratory and the firm was asked to commence work without delay. In the meantime plans were also ready for the adjacent front block for optics, photometry and electronics and on the suggestion of the Local Advisory Committee, contract for the construction of this block was also given to Messrs. National Construction Co.

In view of the special nature of air-conditioning requirements it was considered desirable to appoint an air-conditioning expert as consultant. Accordingly, Mr. E. Bertsch of the firm of Messrs. Volkart Brothers, Bombay, was appointed as consultant in July 1947.

The Governing Body of the Council of Scientific and Industrial Research at a meeting held on the 25th August 1947 appointed a Sub-Committee consisting of Mr. J.R.D. Tata and Mr. Kasturbhai Lalbhai to go into the question of architectural features and elevations of the various buildings of the National Chemical and National Physical Laboratories. The plans submitted by the architects have been revised on the basis of the recommendations of this Sub-Committee. The revised plans were approved by the Sub-Committee on the 12th December 1947. In the meantime excavation had begun in August 1947 but no actual construction could begin until the final approval of the plans by the Tata-Kasturbhai Committee. Active construction work is now going on. Plans are also in hand for the construction of a full size model of one room of the laboratory to work out details of piping, wiring and drainage. This model is expected to be ready by March 1948.

National Metallurgical Laboratory, Jamshedpur.

At its first meeting held on 7th December, 1940, the Metals Committee, after a close examination of the future development of the country's metallurgical industry, came to the considered decision that to ensure its progress and expansion, a central organisation in the form of a National Metallurgical Research Laboratory was essential. The Metals Committee, therefore, in the minutes of this meeting suggested that "the attention of the Board be drawn to the eminent suitability of Jamshedpur as a centre for metallurgical research and that a recommendation be made to the Board and Government that a scheme involving the erection of a building, the purchase of equipment and the employment of staff be financed to make the proposal workable."

A Laboratory Planning Sub-committee of the Metals Committee was later constituted to formulate a concrete scheme for submission to the Board of Scientific and Industrial Research. This Sub-committee was composed of the following:—

Sir J. J. Ghandy, C.I.E.	Chairman
Sir S. S. Bhatnagar	Member
Sir Cyril S. Fox	"
Mr. R. A. MacGregor, C.I.E.	"
Mr. E. V. Parkinson	"
Mr. N. Hackney	"
Dr. D. Swarup	"

The Laboratory Planning Sub-committee entrusted Messrs. Ballardie Thompson and Mathews, a firm of architects to translate their recommendations into definite plans. The architects submitted their proposals to the planning committee who estimated that the cost of the project would be of the order of Rs. 60 lakhs. An *ad hoc* committee of the Board of Scientific and Industrial Research was formed and resolved "to recommend the establishment of a Metallurgical Research Laboratory at an initial cost of about Rs. 30 lakhs inclusive of building and equipment and a recurring annual cost of Rs. 3 lakhs. The cost should be spread over a period of years by splitting the laboratory into blocks. As the Geological Survey of India, the Madras Government and all metallurgical industries in India were interested, the committee hoped that they would all contribute to the capital and recurring expenditure". This recommendation of the committee was generally accepted by the Board.

In October 1944 the Board appointed the National Metallurgical Laboratory Planning Committee with the following personnel to attend to the detailed planning work.

Sir J. J. Gandy, C. I. E.	Chairman
Sir S. S. Bhatnagar	Member
Director, Geological Survey of India	„
Mr. R. A. MacGregor, C.I.E.	„
Mr. E. V. Parkinson	„
Dr. G. P. Contractor	Secretary

Dr. Contractor assumed charge of his duties as Assistant Director (Planning) in November 1944.

The National Metallurgical Laboratory, when completed will cover all aspects of metallurgical research, both fundamental and applied and will also carry out research work on ores, minerals and refractories as applied to metallurgy.

With the rapid growth of industries in the country and their future stability there has arisen the need of a central station for carrying out research on minerals, complete with pilot plant facilities for their industrial development. The urgency of having such a station has now further increased with the recent abolition of the war-time created 'Utilisation Branch' of the Geological Survey of India. The preparation of minerals and ores and the smelting of the latter are so definitely a part of the development of the country's metallurgical industries that the sub-committee suggested facilities for mineral research be provided at the National Metallurgical Laboratory. The then Director of the Geological Survey, who was also a member of the sub-committee, was consulted on this particular aspect of the laboratory's functions and he agreed that the inclusion of minerals research within its scope was most desirable.

As the metallurgical industry is one of the biggest consumers of refractories, the sub-committee was also of the opinion that research work on refractories should also be associated with that on metallurgy and that work on metallurgical furnace design might also be undertaken. Work on refractories would be greatly facilitated by the presence of the minerals research section with its specialised laboratory and pilot plant equipment.

In consequence, provision has been made in the final plans of the National Metallurgical Laboratory for administration including statistics,

chemical analysis, physical chemistry, physics as it affects metallurgical problems, the examination, preparation and smelting of metallic ores; the melting, heat treatment and working of metals and alloys; the electro-deposition and surface treatment of metals and research on refractories, together with facilities for the application of research results to commercial operating conditions and for the study of such conditions as they effect the quality of the products and the efficiency and economy of commercial production.

The National Metallurgical Laboratory will work in close collaboration with the other National laboratories particularly on long term research of a fundamental nature.

While being fully aware of the great importance of fundamental research to the metallurgical industry, the sub-committee were of the opinion that close contact between the research workers and the industry itself was also essential in order to maintain that outlook so necessary for the successful adaptation of research results to industrial practice. Therefore, the committee proposed that the National Metallurgical Laboratory be established at Jamshedpur where excellent facilities for the study of practical operating problems are available at the works of the Tata Iron & Steel Co., Ltd; the Tinplate Co. of India; the Indian Steel & Wire Products; the Indian Cable Co.; the Tatanagar Foundries and the Jamshedpur Engineering & Machine Manufacturing Co. The Indian Copper Corporation is close-by, while most of the engineering industries are centred around Calcutta. Furthermore, the other two proposed National laboratories, viz., the Central Glass and Ceramic Research Institute and the Feul Research Station are planned close-by to be established in Calcutta and Dhanbad respectively. The possibility of close collaboration with the Government Metallurgical Inspectorate situated at Jamshedpur and with the Research and Control Laboratories of the Tata Iron & Steel Co., Ltd., is also an additional advantage.

A very suitable site for the National Metallurgical Laboratory was available at Jamshedpur to the east of and adjoining the Tata laboratories, while opposite are the laboratories of the Government Metallurgical Inspectorate. The steel company very kindly offered to make this site available. The site is extensive and provides an adequate area for the purpose. The problems of power, water and gas supply and sewage and effluent disposal will be the same as those that were successfully

solved at the time of the erection of the Tata laboratories. In addition, all services are available close to the site.

Some criticism might be levelled at this choice of site as the climate of Jamshedpur is hot during summer season, a site in a more moderate climate being probably preferable. The sub-committee were of the opinion that the practical advantages of establishing the laboratory at Jamshedpur far outweighed the disadvantages of climate, particularly as the hot season was of a relatively short duration being approximately 8 to 10 weeks a year. However, the question of air-conditioning the laboratories or part thereof by either evaporative cooling system or by mechanical refrigeration was comprehensively studied by the air-conditioning engineers who were furnished with the last five years' figures of local temperature and relative humidity during summer months. Based on their recommendations the planning committee has finally decided to provide air-conditioning by refrigeration to laboratory rooms, offices, library, conference rooms etc.

Evaporative cooling system was found on detailed examination to be unsuitable under local temperature and humidity conditions. Storage rooms, shops and similar interiors will not be air-conditioned. This decision was made at an early date as the design and the outward appearance of the laboratory building were dependent upon the provision or otherwise of air-conditioning facility. With air-conditioning, a building embodying tall and extensive window features can be adopted which will provide efficient internal lighting which is very desirable. In the revised estimates given later, the cost of air-conditioning has been included.

When formulating its views regarding the laboratory and other facilities to be incorporated in the National Metallurgical Laboratory, the sub-committee were guided by the principles that the pilot plant sections should be separate but readily accessible from the main administration and research block so as to avoid disturbance therein from vibration, noise, dust, etc., generated by semi-commercial scale operations; that the chemical and similar laboratories be segregated together away from those in which work of more physical nature would be carried out; that provision be made for the educational aspect of metallurgical research by the inclusion within the scheme of an industrial museum and a lecture theatre fully equipped with modern projection apparatus and the laboratories and the semi-pilot plant sections to be so planned as to be capable of future extension.

The sub-committee envisaged that the construction and equipping

of the laboratories would be spread over a number of years and for this purpose assumed an over all period of five years, the first year being occupied in detailed planning, drawing up of specifications, etc., actual construction proceeding in the second to the fifth years. In order to permit of the orderly development of research and pilot plant work proceeding during the constructional period, the architects were instructed to draw up their plans accordingly.

The total scientific staff of the laboratory will be about 30 and the administrative and workshop staff about 50. The capital expenditure is expected to be approximately 51.5 lakhs and the recurring expenses on completion in the 5th year are estimated at 5 lakhs. The pioneer House of Tatas have made a donation of Rs. 12 lakhs and Messrs. The Indian Steel Products Ltd., Jamshedpur and the Indian Metallurgical Industries have contributed Rs. 1 lakh each towards the cost of establishing the National Metallurgical Laboratory.

The foundation stone of the National Metallurgical Laboratory was laid on the 21st November 1946 by His Excellency Shri Rajagopalachari, then Minister for Education and Arts in the Interim National Government in the presence of a distinguished gathering. The architects were thereafter requested to proceed with the preparation of the working drawings and detailed estimates of the Technological Block which were circulated to the Local Advisory Committee in June 1947 and it was decided to call tenders for the construction of the Technological Block. The tenders were received on the 21st August 1947 and after examination by the architects and the Local Advisory Committee, it was decided on the 26th October 1947 to award the contract to Messrs. Engineer Syndicate (India) Ltd., and steps to enter into a final agreement with the contractors are in hand. The construction of the Technological Block is estimated to cost Rs. 4,75,000.

Detailed arrangements in individual bays of the Technological Block with regard to the arrangement of heavy and light machines, furnaces, electric smelting and treatment, pilot assemblies, services (gas, water, air and electricity), etc., are under preparation. Plans showing the arrangements of the machines, etc., together with ancillary objects and services have already been sent to the architects for their comments. Further detailed arrangements will shortly be ready for discussion with the architects. The architects have so far expressed their entire satisfaction with the arrangements as they

do not appear to interfere with the architectural requirements of the Technological Block.

In addition to the above progress very comprehensive lists of equipment, apparatus, machines, etc., estimated at Rs. 18 lakhs were prepared during the period under review. Detailed specifications and precise desiderata were drawn for individual items and this necessitated considerable time and study. In order to make estimates accurate leading manufacturers of apparatus, instruments, machines, pilot assemblies, etc., were requested to give the prevalent prices and other information which may be useful in the preparation of detailed specifications. As a result, very compendious lists of equipment, etc., with approximate current prices have been prepared.

Strenuous attempts were also made during this period to purchase back numbers of scientific journals, periodicals, etc., as a preliminary step to build the library of the National Metallurgical Laboratory. Various American, British, French and German publishers and booksellers were contacted in this connection and firm orders to the value of Rs. 36,000 have been placed. Some of the back numbers have already been received in the office of the National Metallurgical Laboratory where they are carefully kept.

Regarding the purchase of laboratory equipment, etc., the materials available with the D.G. Disposals, Govt. of India, were scrupulously studied and those useful were sorted out for purchase. A representative of the National Metallurgical Laboratory was deputed to visit various depots to examine the condition of the machines available and find out their suitability or otherwise. As a result, firm orders for machines costing about Rs. 24,000 have already been placed with the D.G. Disposals. Further orders to the value of nearly Rs. 3 lakhs are expected to be placed shortly.

**National Fuel Research Institute
Digwadih-Dhanbad**

The importance of exploring ways and means to ensure proper utilisation and conservation of a country's coal, oil and other fuel resources has been recognised by all the important industrial countries and institutes for fuel research have been established in the U. K., U. S. A., France, Germany, Soviet Union and other progressive countries. The appointment of the Fuel Research Committee was a natural outcome of the

decision of the Government of India to establish the Board of Scientific and Industrial Research, and was a clear indication of the fact that the importance of fuel was appreciated by the Government.

The present composition of the Fuel Research Committee is :—

A. Farquhar Esq.	Chairman
B. Wilson Haigh Esq.	Member
Dr. C. Forrester	"
Director, Geological Survey of India	"
D. N. Wadia Esq.	"
Dewan Bahadur D. D. Thacker	"
H. Bennett Esq.	"
Sir J. C. Ghose	"
K. B. Sen Esq.	"
Prof. M. Qureshi	"
Prof. N. N. Chatterjee.	"
W. Kirby Esq.	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>
Dr. J. W. Whitaker	"
Dr. A. Lahiri	Secretary

The Fuel Research Committee at its first meeting in August 1940 recommended that its main objective should be the establishment of a Central Fuel Research Station for India. This recommendation was considered and discussed from time to time and in December 1943, the Governing Body of the Council of Scientific and Industrial Research approved the establishment of the Fuel Research Institute at a cost of Rs. 3 lakhs.

This decision of the Governing Body was followed by the appointment early in 1944 of a Local Planning Committee for conducting the day to day work for the establishment of the Fuel Research Committee, with the following personnel :—

W. Kirby Esq.	Chairman
A. Farquhar Esq.	Member
B. Wilson Haigh Esq.	"
Dr. C. Forrester	"
Dewan Bahadur D. D. Thacker	"
S. K. Nargundkar Esq.	"
Dr. A. Lahiri	Secretary

Dr.A. Lahiri was appointed Assistant Director (Planning) and assumed charge of his duties in June 1945. His duties were to draw up a sketch plan for the buildings and requirements for the National Fuel Research Institute. This plan was accepted and Messrs. Ballardie, Thompson, & Mathews were appointed architects in November 1945. They drew up building plans, which were modified from time to time to suit the budget allotments. Dr. J. W. Whitaker till recently Principal of Huddersfield Technical College was selected Director of the National Fuel Research Institute and joined his duties on 1st April 1946.

The Fuel Research Committee appointed a site selection committee which after much deliberation, decided upon the present position at Digwadih 10 miles south of Dhanbad. Here the superior rights of about 150 acres of land were donated to the Council of Scientific and Industrial Research by the Raja of Jharia, Babu Shiv Prasad Singh, M.B.E. The Institute will be in a growing industrial area, being in close proximity of the synthetic fertilizer plant at Sindri and the Digwadih colliery of the Tata Iron and Steel Co., Ltd. The site is excellently located as it is situated in the heart of the major coal producing fields of India. Electricity and water supply in the initial stages will be available from Tata's colliery nearby. The power requirements of the future will be met from the proposed grid system in Bihar. Wells will be sunk for water supply. When completed, the institute will have the following divisions:—

1. Physical and Chemical Survey of Coal Resources (including field laboratories).
2. Carbonization and By-products (including colloids and rheology sections, tars and plastics).
3. Liquid Fuel Division (including hydrogenation, synthetic fuels, petroleum, alcohol, etc.).
4. Physics Division (including pyrometry, calorimetry, heat transference, x-ray and spectroscopy).
5. Gaseous Fuels Division (including combustion control).
6. Engineering Division (including preparation of coal for the market, boiler plant, etc).
7. Library and Intelligence.
8. Administration and Office.

All the divisions of the Institute are expected to cooperate in the conduct of research schemes since no clear cut distinction can be maintained

and team work of the highest order will be required for furthering the object for which the institute is intended.

The present programme comprises a preliminary survey of the chief seams including proximate and ultimate analysis, washability tests, ash analysis and tests, coking tests, carbonisation assays, gasification tests and investigations into tar. Subsequent work will include more detailed examination on the above lines and further researches into the utilisation of the coals, either directly as fuels or indirectly as the products of carbonisation, complete gasification, hydrogenation and synthetic processes. Work will also be done on Indian oils and fuels not derived from coal such as wood and alcohol. At the same time fundamental research will not be neglected. Pilot plants will be constructed as required.

It is expected that the construction and equipment of the laboratories and workshops will occupy two years. The third and fourth years will be devoted largely to the construction of plant. Broadly speaking, the lay-out is divisible into three main portions, namely the administrative section, the laboratories, and the Technological Block. Due to the climatic conditions, air-conditioning will be provided for the administrative and laboratory sections.

The administrative section comprises: (a) Officers' rooms (b) Office accommodation for clerical staff (c) Map and record rooms (d) Visitors', post, telephone and messengers' rooms (e) Conference and lecture rooms (f) Drawing office (g) Statistics and intelligence room (h) Library and reading room. The library will form the Central Fuel Library for India and will have a Statistical Section. The conference room may be used for lecture purposes and will be equipped accordingly.

The Laboratory section comprises rooms for (a) stores and services (b) general analysis and fuel testing for coal survey purposes (c) carbonization, by-products, and liquid fuel investigation (d) physical and gaseous fuel research (e) special researches and (f) coal preparation and purification.

The stores block, which is placed near the centre of the laboratories for convenience, stands taller than the adjoining rooms. Three floors are provided, each 10 ft. high, thus affording suitable rooms for storage. Distilled water will be taken from a still housed on the roof and led to various points in the laboratories.

The General and Coal Survey Laboratories will include rooms for ash estimation, for ash fusion tests and for research on refractories; inorganic chemical laboratories; rooms for high and low temperature assay, and coking and swelling tests; rooms for determination of moisture, volatile matter, carbon dioxide, etc., and for the ultimate analysis of coal; an inorganic analytical laboratory for determination of sulphur, phosphorus, arsenic, chlorine, etc., calorimetry and balance rooms, preparation and solution rooms and a small office.

For Carbonization, By-products and Liquid Fuels the lay-out comprises a laboratory for special carbonization experiments; a routine laboratory for carbonization, blending and oxidation tests; an organic laboratory for work on liquid fuels; a physical chemistry laboratory for work on mineral oils and the like; preparation and balance rooms, and a small office.

In the Physical and Gas Research Sub-section rooms will be provided for X-ray and X-ray control; pyrometer testing, ultra-violet and infra-red spectroscopy; gas analysis; combustion and gas research; a special gas research laboratory for fractionation of gases, thermal investigations etc., and a preparation room and office.

For Special Research, provision has been made for work in microscopy, coal petrography and related investigations; section-cutting and polishing; hydrogenation; rheological investigations and particle size determination; colloid research, electrical, magnetic and optical properties; chromatography and photo-chemical analysis; micro-analysis; molecular research; hydro-carbon synthesis; and plastics research. The blocks (D and E) will be allocated to these researches.

For coal preparation, equipment will be installed for making standard tests on the washability of coals. In addition, accommodation and apparatus will be provided for tests on commercial samples; and for special researches on methods of de-ashing of Indian coals, e.g., by froth flotation. Rooms are also allocated for investigations into wetting and frothing and amalgamation agents, with and without fine grinding and for investigations into slurry problems in washeries, the stabilization of coal-cleaning media, etc. These laboratories will be near the Technological Block, within easy access of sampling, crushing, and screening plant.

The nature of the work to be carried out in the Technological Block requires that these buildings should also be removed from the main

Research Laboratories and Administration Buildings. The Technological Block, will have the following facilities :

(1) Weighing, crushing, grinding and sampling plant, and fine grinding equipment; shatter test apparatus for coke; abrasion test apparatus for coke; screens; a room for the storage of samples for reference (2) General stores; precision instrument shop (3) General workshops (4) Room for electrical power distribution (5) Semi-technical carbonization ovens (6) Small gasification, hydrogenation, and artificial oxidation plant (7) Boiler and pulverized fuel firing equipment (8) Vibrator screens for screen analysis on large scale samples and (9) Small foundry.

Space is provided for boiler and other plants which may be required, e.g. coke ovens, producer gas units, hydrogen generators, low temperature carbonization plant, tar-hydrogenation plant, refineries, gas holders, Fisher-Tropsch units and coal washing plant.

A railway siding will be available for the Technological Block and the above plant in due course. Meanwhile permission has been obtained to use the nearby railway siding of Tata Iron & Steel Co. Motor transport will be used to the Institute.

The scheme is expected to cost Rs. 14 lakhs as non-recurring expenditure and Rs. 2.5 lakhs as recurring expenses during the first five years. The recurring expenses are expected to increase to 5.5 lakhs after the first five years.

The foundation stone of the building was laid by the Hon'ble Mr. C.H. Bhabha on the 17th November 1947 before a distinguished gathering of those interested in coal and others.

The present position with regard to the building is as follows :—

1. Negotiations have been completed for taking over the estate, which amounts to 170 acres.

2. The building of the Laboratories Block for the physical and chemical survey of Indian coals has commenced in August 1947. The necessary cement and steel however are not yet to hand. Tenders have been called for the building of the Technological Block—approximate estimate of Rs. 3½ lakhs. Detailed plans have also been considered with the architects for the Administrative Block. It is proposed to call for tenders in the near future.

3. Arrangements have been made for supplies of water and electricity. Wells have been cleaned and sunk and the agreement completed for the supply of electricity from the power station of the Tata Iron & Steel Co. Details of the layout are under consideration by the engineer of the architects. It is important to allow for connection to the new grid scheme in the course of a few years.

4. The housing scheme is making slow progress. The layout of the estate is under consideration by the C. P. W. Dept. Concerning the layout of the grounds, the Secretary of the Council of Scientific & Industrial Research has approached the Horticultural Adviser to the Government. It is hoped to have the benefit of this expert guidance.

EQUIPMENT AND APPARATUS.

1. To avoid delays a temporary laboratory at Dhanbad has been equipped. Here the work of coal analysis and testing, including the survey of coals and their washability, will be done until the laboratories at Digwadih are available.

2. A library is being formed. Books and journals to the value of Rs. 15,000 have been ordered from abroad, in addition to books to the value of Rs. 500 purchased in India.

3. Laboratory apparatus and supplies to the value of Rs. 50,000 have been ordered from abroad and to the value of Rs. 15,000 in India.

STAFF.

1. The technical staff consists of 1 Director, 1 Assistant Director, 1 Scientific Officer, 1 Junior Scientific Officer, 6 Scientific Assistants, 1 Draughtsman, 1 Librarian and Statistical Assistant and 1 Works Overseer. A Chief Engineer has been selected and is expected to join shortly.

2. The office staff consists of 8 administrative assistants, and 9 others.

RESEARCH AND INVESTIGATIONS.

1. A survey has been made of the published work on Indian coals and a preliminary coal classification made following the U.S.A. scheme of Parr. The broad categories of Indian coals are becoming apparent, but there are unusual features in the coals of Assam and of the Punjab.

The geological structure and resources of the Jharia and Raniganj coalfields are being studied from sections, maps, and records of bore holes in order that correlation of the analysis with geological structure and quantities of coal available may be easily effected at a later stage.

2. Indian coals and conditions necessitate special care in determination of moisture. The quality of the ash is also important. Work has been inaugurated on both these subjects.

3. Special attention is also being paid to the precise determination of (1) calorific value and (2) phosphorous content in coal and coke.

ORGANISATION AND GENERAL.

1. The Assistant Director acts as Secretary of the Fuel Research Committee. By this means the Institute maintains active contact with the various subsidised fuel researches of the country. Collaboration has also been effected with the scientific staff engaged on the dynamometer-car work of the railways.

2. It is proposed to form Coalfield Survey Committees to advise and help with the physical and chemical survey work. Two committees are proposed at the start, one for the Jharia field and one for Raniganj. Preliminary steps to constitute these committees have already been taken up.

Central Glass and Ceramic Research Institute, Calcutta.

The need for the establishment of this institute was first considered in early 1942 and after some meetings the committee that was appointed to advise on the formulation of the scheme with Sir S. S. Bhatnagar as chairman finally submitted its proposals in June 1944 to the Governing Body which on 1st August 1944 decided the following:—

1. That the Institute be located at Calcutta.
2. That a sum of rupees twelve lakhs be provided for the capital expenditure of the Institute.
3. That Messrs. Ballardie Thompson & Mathews, Chartered Architects 7, Wellesley Place, Calcutta, be appointed architects for the institute.

The functions of the Institute were to be:

1. Fundamental research having a bearing on different branches of glass and ceramics.

2. Testing and standardisation.
3. Technical assistance to the industry.
4. Dissemination of information.
5. Training of technologists.

The foundation stone of the Institute was laid by the Hon'ble Sir Ardesbir Dalal, then President of the Council of Scientific and Industrial Research on the 24th December 1945.

Apart from the grant sanctioned by the Council of Scientific and Industrial Research, 3 donations of rupees ten thousand each have been received from Dr. Sir U. N. Brahmchari, Mr. I. G. Varshney and the Bengal Glass Manufacturers Association. These donations signify the interests of the industry and the public in the establishment of this institute.

The site of the Institute is at Gariahat Road near the College of Engineering and Technology, Jadavpur, where it now has a 20 bighas plot on a 76 years' lease from the Calcutta Corporation on an annual rent of Rs. 600. This land has been procured mostly through the good offices of the College of Engineering, the original leasee of the land and the Corporation of Calcutta, the owner.

The plans of the buildings were prepared by Messrs. Ballardie Thompson and Mathews, architects to the Institute, in consultation with the officers of the Institute and scrutinized by the advisory sub-committee. Since the Institute is concerned with research on industrial subjects the buildings has been divided into two sections : main laboratory and the Technological Block. It was decided that the Technological Block should be constructed first. After the plans had been approved by the advisory sub-committee and after scrutiny of the tenders submitted for this part of construction, the work was entrusted to Messrs. A. K. Sarkar (Builders) Ltd., Calcutta in August 1945. Although the contractors commenced work immediately and it was estimated that it would be completed in six months time yet due to several factors it has taken nearly two years to complete the building which is now receiving finishing touches.

The area of the Technological Block that has been built is about 13 to 14 thousand sq. ft. The rooms in this block are : the big experimental furnace room, the treatment of raw materials room, clay working laboratory, refractories laboratory, workshop, heavy store rooms and two other store rooms that are at present converted into sitting rooms and temporary chemical laboratory and other small auxiliary rooms like privies etc.

The three important services, gas, water and electricity in this block has been completed by Messrs. J. B. Norton & Son, Calcutta and S. K. Mitra Ltd., Calcutta. The work on laboratory fittings such as laboratory benches, fume cupboards etc. was entrusted to Messrs. Mansfield, Calcutta, last year and is still in progress. All the material has been brought to the site and the work is expected to be completed shortly.

At the site of the Institute there was no provision for the supply of water by the Calcutta Corporation, nor was there adequate arrangement for the supply of gas by the Oriental Gas Co. The power lines of the Calcutta Electric Supply Corporation were sufficient for the demand of the Institute and they have already made arrangements for the supply of consumption expected in the Technological Block. Regarding water, a 5 inch tubewell which is expected to deliver water to fulfil the maximum requirements of the Institute, both present and anticipated, has been sunk at the site by Messrs. Scott & Saxby and a separate pump house to provide pumping installation has been built by Messrs. A. K. Sarkar and is nearing completion.

For the supply of gas, after protracted negotiations arrangements were made with the Oriental Gas Co. on the latter's laying a pipe suitable for the requirements of gas at their own expense on the condition that the Institute guarantees a minimum consumption per month. This figure is in agreement with the consumption of gas that is expected at the Institute in view of the installation of a number of moderate sized furnaces. The gas company has already completed the work and has brought the connection to the premises of the Institute. As the pressure of gas at the point of delivery by the company is not sufficiently high, a booster is being installed and according to the information supplied by the contractors, Messrs. J. B. Norton & Sons, entrusted with this job, it is expected to arrive from abroad soon. Till that time the gas company is making a connection to the Institute's installation so that some work could be started even at low pressure.

The initial requirements of equipment for the Institute were drawn up in conformity with the functions and nature of work of the Institute almost immediately after the starting of the building work. In drawing up the specifications for the requirements, special attention has been paid to the requirement for pilot plant experiments which is of special

importance in a technological research institute of this type. The Officer-in-charge (Dr. Atma Ram) was deputed last year to visit U.K. and U.S.A. after completing his visit to Germany and authorised to purchase equipment to the extent of Rs. 2 lakhs from the total amount of Rs. 5 lakhs earmarked for this purpose. Due to an unfortunate accident which he met in Germany during his visit, this work was delayed by a few months. When early 1947, after collecting quotations and other things the work of placing orders was to be undertaken, he was suddenly recalled to India on account of dislocation in the work of the Institute here. But he had placed orders for some items of equipment in England, some of which, such as the platinum articles, have already arrived. Orders for other urgent equipment have already been placed after his arrival in India and more are being placed within the limit of Rs. 2 lakhs. These orders cover only some of the initial equipment that is needed for such a laboratory and a sum of Rs. 3 lakhs is kept in reserve pending the appointment of the Director, who will arrange for the purchase of further equipment.

While visiting Germany the Officer-in-Charge requisitioned a few machines and other pieces of equipment which were considered useful for the Institute. It is learnt that a shaping machine has already been allotted to the Institute and will shortly be shipped from Hamburg, and several analytical balances which were a speciality of Germany have also been ordered.

During the visit of the Officer-in-Charge to England two special units for the processing of glass sands and clays, one sand washing plant and a magnetic separator had been promised to him as free present by Messrs. Hardy & Padmore of Worcester and Messrs. Magnetic Machine Co., Birmingham, for work at the Institute. It is learnt that one of these units, the first one, will be leaving England in a short time.

The acute shortage of equipment is well known. The price of equipment has gone up and the position of supply has considerably deteriorated after the cessation of hostilities. But during his personal contacts with the directors of the firms with whom orders have been and are being placed, the Officer-in-Charge was assured that every priority will be given to the equipment intended for the Institute. It is expected that some of these orders may be supplied in the next six months. In this connection he received great assistance from glass and ceramic laboratories, Department of Scientific and Industrial Research and the Ministry of Supply, England.

All details regarding construction of furnaces and the installation of equipment have already been prepared for every room of the Technological Block. Sanction has now been obtained for undertaking some of this work, and quotations have been invited for getting the materials. The chimneys required for the furnaces have already been ordered and are expected to be delivered very soon when construction of the furnaces will be undertaken. The equipment will be fitted as and when it is received here.

It is proposed to have at the Institute a museum representing the important features of these industries and also the finished products. During the visit of the Officer-in-Charge to Germany and U.K., quite a number of useful samples, charts, drawings etc. have been collected. Some of these have already arrived at the Institute and have been displayed.

The library of the Institute is being organised so as to serve as a library not only for the Institute but for those industries in which individual factory owners cannot be expected to maintain a good library of their own. With this object in view, back volumes of important journals like Journal of the Society of Glass Technology, Sheffield, Journal of the American Ceramic Society, Transactions of the British Ceramic Society, Journal of the Canadian Ceramic Society, Glass Industry, Glass etc. have already been received. Back volumes of the Chemical Abstracts are being ordered from the publishers. The first instalment of books required for the Institute was ordered about $1\frac{1}{2}$ years ago and considering the acute shortage of books, the position has not been too bad. About 50% of the books have been received and many out of print but being printed are still on standing order. The next instalment of books is now ready and will be ordered in course of the year. In addition to this a very large number of catalogues and other descriptive pamphlets regarding equipment, both for the library and for the industries have been collected during recent visits to foreign countries and are kept in the library. Several firms are supplying very useful technical data which are expected to be of very great assistance in the work of the Institute.

The Institute is a standing subscriber to about 46 important scientific and technical journals on glass and ceramics and other sciences related to these subjects.

The main building of the Institute which is to house laboratories for fine type of work, museum, library, offices etc. has been planned. It is

at present contemplated to be a two-storied building and has been so laid out that the rooms requiring air-conditioning such as sitting room, special laboratories, library etc. are placed in one floor. The plans of this building are now to be approved by the Local Planning Committee and the architects will soon circulate the detailed bills of quantities, when tenders will be invited for undertaking its construction. Depending upon the amount of money available, it is at present proposed to construct as much of the building as possible keeping in view the structural and engineering aspects.

Advisory Board of the Institute.

To advise the Council regarding the affairs of the Institute there is an Advisory Board with the following personnel :—

Prof. M. N. Saha, F. R. S.	Chairman
Prof. P. Ray	Member
Mr. D. N. Sen — Representative of Glass Manufacturers' Federation	»
Mr. M. M. Sur — Representing the Ceramic Industry	»
Sir Biren Mookerjee	»
The Director, Geological Survey of India	»
Director, Scientific and Industrial Research	<i>Ex-officio</i>
Dr. Atma Ram	Secretary

The functions of this Board are :

(a) to submit to the Council of Scientific and Industrial Research a programme of the work of the Institute at the beginning of each year.

(b) to review the progress of the Institute and to recommend to the Council of Scientific and Industrial Research proposals for development.

(c) to frame the budget of the institute and submit it to the Council of Scientific and Industrial Research for consideration.

(d) to discharge any other function which may be assigned to it by Council of Scientific and Industrial Research.

This Board was constituted in January 1946. It has held five meetings and keeps the Council informed about the affairs of the Institute.

Local Planning Committee for the Institute.

The previous Advisory Sub-committee which was concerned with the scrutiny of building plans was dissolved in March 1947 and a Local Planning Committee to advise on the architectural and constructional matters of the Institute has been appointed with the following personnel.

Prof. M. N. Saha	Chairman
Dr. A. H. Pandya	Member
Mr. M. G. Bhagat	"
The Superintending Engineer, Bengal Circle, Central Public Works Department, Calcutta.	"
Director, Scientific and Industrial Research	<i>Ex-officio</i>
Dr. Atma Ram	Secretary

It has had one meeting when it discussed the tentative plans for the main building which have now undergone considerable modifications in view of some important decisions regarding air-conditioning of the buildings.

Technical Work by the Staff

During this period although technical members of the staff had to be busy in planning the laboratories and preparing detailed requirements and specifications of the equipment for a considerable part of the time, they have devoted time for technical work. The Institute received 85 technical enquiries covering information on various subjects. These have been attended to. It may be mentioned that due to the delay in equipment full fledged laboratory facilities are not yet available and in the absence of these as many of the enquiries as could be attended to with the information at the disposal and experience of the staff have been attended to. Several of these requests concerned preparations of plans and designs for the factories and might involve the Institute in responsibility of their workability. The policy regarding technical assistance in such matters is not yet finally decided and pending that these requests have been declined.

During this period the Officer-in-Charge (Dr. Atma Ram) also acted as a member of the Glass Panel and the Ceramics and Refractories Panel of the Department of Planning and Development of the Government of India, and rendered as much help as possible particularly in technical matters.

The Road Research Institute, Delhi.

The Governing Body of the Council of Scientific and Industrial Research at their 9th meeting held on the 21st September 1945 agreed in principle to the setting up of a Road Research Institute for India. A joint meeting of the sub-committee appointed by the Governing Body of the Council of Scientific and Industrial Research with the representatives of the War Transport Department was held in Delhi on the 9th November 1945. A Road Research Advisory Committee with the following members was constituted to consider and recommend the lines on which the Road Research should be planned.

Sir Kenneth Mitchell	— Representative of the Transport Department	Chairman
Mr. G.M. Mckelvie	— „ „	Vice-Chairman
Dr. H.B. Dunncliff	— „ „	Member
Lt. Col. C.M. Singer	— Representative of the Engineer-in-Chief	„
Dr. L.C. Verman	— Representative of the C.S.I.R.	„
Dr. M. Qureshi	— „ „	„
Sir S.S. Bhatnagar	— Director, Scientific and Industrial Research	<i>Ex officio</i>

The joint meeting also decided to request the Consulting Engineer to the Government of India (Roads) to recommend a suitable place for the location of the Institute. The Consulting Engineer recommended that the Institute be located at a place near about Delhi. This recommendation was considered at the 11th Meeting of the Governing Body and it was decided to call for the opinion of experienced road engineers of different provinces on the note and recommendations of the Consulting Engineer to the Government of India. Accordingly tentative proposals were sent in December 1946 to all the provincial chief engineers in charge of road development schemes who unanimously favoured the establishment of a

Road Research Institute for India and recommended Delhi as the most suitable place to locate it.

The Governing Body at their 12th Meeting held on the 9th February 1947 after carefully considering the views of the provincial engineers decided that a Road Research Institute under the auspices of the Council of Scientific and Industrial Research should be established in India and the Hon'ble President was authorized to take a decision on the location of the Institute on receipt of a detailed Note from the Director, Scientific and Industrial Research. The advantages and disadvantages of Delhi, Lahore, Roorkee and Nagpur for locating the Institute were scrutinized and the Director, Scientific and Industrial Research finally proposed in August 1947 that the Institute should be built at Delhi. This has been approved by the Hon'ble President.

With a view to expedite the establishment of the Institute, the Road Research Advisory Committee was reconstituted by the Hon'ble President in April, 1947, consequent on the retirement from service of some of the members of the committee. Subsequent changes were made in November 1947 and the committee as at present constituted consists of the following members :—

Mr. G.M. Mckelvie	— Representative of Ministry of Transport.	Chairman
Mr. K.S. Ragbavachary	— -do-	Member
Lt. Col. C.M. Singer	— Representative of the Engineer-in-chief.	„
Sir K. S. Krishnan	— Representative of the Council of Scientific & Industrial Research.	„
Dr. M. Qureshi	— -do-	„
Mr. C.G. Kale	— President of the Indian Roads Congress	<i>Ex-officio</i>
Sir. S.S, Bhatnagar	— Director, Scientific & Industrial Research.	<i>Ex-officio</i>
Dr. R.K.N. Iyengar	— Asstt. Director (Planning), C.S.I.R.	Secretary.

Dr. R.K.N. Iyengar, formerly Assistant Engineer Consultant, Ministry of Transport, Govt. of India, was appointed Assistant Director

(Planning) for preparing the detailed plans and estimates of the Institute and he took over charge of his duties from the 1st of August 1947.

Possible sites for the Institute in the neighbourhood of Delhi were inspected by the Consulting Engineer (Roads) and the Assistant Director (Planning) and a site on the Delhi-Muttra road in the extensive area between Humayun's Tomb and Purana Qila was considered most suitable and has been finally selected. The Director, Scientific and Industrial Research and the Hon'ble President have approved the site and action has now been initiated for the acquisition of 100 acres of land in this area. It is expected that the required land would be available at an early date so that measures might be undertaken for the design and construction of the Institute and other installations and for appointment of architects for this purpose.

The first meeting of the Road Research Advisory Committee was held on the 3rd December 1947. The Committee agreed generally with the outline plans and proposals for the buildings, organisation and staff put up by the Assistant Director (Planning). The Assistant Director (Planning) is now preparing a draft plan on the lines discussed in the meeting.

The Road Research Institute when established will foster and promote road research on the same general lines as those in the United Kingdom and United States of America, with suitable modifications to ensure adaptability to Indian conditions. There shall be one main field experimental station near the Institute and other field stations in various suitable places in different parts of the country. The Council of Scientific and Industrial Research shall be responsible for the institute and laboratory staff, while the field experimental stations shall be financed and controlled by the Central Road Board under the Government of India.

It is proposed that the Road Research Board consisting of technical representatives of the Government of India, Provincial Governments and the Council of Scientific and Industrial Research should be set up for controlling and directing the research work in the Institute and the experimental stations. There should be the closest cooperation between the laboratories under a Director of Road Research, and field experimental stations under a Director of Technical Coordination so that the results of research obtained in the laboratory and testing

stations could be easily and quickly coordinated. A Road Research Advisory Committee consisting of road engineers, scientists, and representatives of road industry should be constituted to advise the Central Road Board of the Government of India and the Road Research Board on research work to be carried out in the central institute and field experimental stations throughout the country and to coordinate all road research work in the country. Finally, there should be an efficient organisation for establishing intimate liaison and effective cooperation on road research problems between the central and provincial stations and other organisations in different parts of the country doing similar work and for disseminating the results of research and experiments.

Functions :—The Road Research Institute is expected to foster the development of road research, leading to improved methods of design and layout of roads in a systematic, efficient and economical manner for the benefit of the common man and advancement of the cultural and industrial development of the country.

The most important functions of the Institute will be :—

1. Fundamental research underlying the behaviour of materials used in road construction and to devise methods of measurement for this purpose.
2. Investigations for securing a degree of calibration for enabling reliable estimates to be formed of the behaviour of various road materials in practice.
3. Tests on various types of soils and accelerated testing work for road making materials.
4. Research connected with the standardisation of specifications for roads and road building plants and machinery, and to evolve basic and correct standard of materials and designs.
5. Testing laboratory products and specifications as far as possible under actual working conditions, and to devise instruments for tests on the roads and other factors of scientific interest in determining the relation between the road and the vehicle.
6. Research on characteristics of different types of roads under different traffic conditions, incidence of accidents, road safety and road statistics.

7. Dissemination of results of research and experiments by means of pamphlets and journals for the benefit of practising engineers.

8. Coordination with institutions and industrial concerns doing similar work and tendering technical advice and assistance.

9. Training of technical personnel :

The Road Research Institute will consist of the following Divisions :—

(i) *Physical Section*—to deal with abrasion, attrition, cementing value of aggregates, modulus of flexural strength for concrete-microscopic examination-petrology-compressive tests.

(ii) *Chemical Section*—to deal with the development of analysis for bituminous mixtures, examination of samples from roads of known characteristics, titration tests, salts, utility and penetrometer tests.

(iii) *Materials Section*—will deal with work on aggregates, fillers, mixtures with hydraulic binders.

(iv) *Soils Section*—will carry out work on the mechanical and physical characteristics of soils, soil stabilisation for low cost roads, deleterious salts in the soil like sodium sulphate.

(v) *Structural Section*—for conducting experimental stress analysis on models of structures such as bridge members, retaining walls, fatigue of metals, etc.

(vi) *Road Section*—for carrying on out-door tests at the research station on skidding and side slipping, vibration, tractive resistance, impact, surface irregularities etc. and accelerated tests under controlled conditions, and performance of different types of road surfaces etc., as also field control tests in actual road conditions and correlation to laboratory tests.

The scientific and technical staff is expected to consist of one Director, one Deputy Director, Heads of Divisions (Assistant Directors), senior and junior research officers and research assistants, totalling about 75, along with about 40 for the administrative and ministerial staff, and about 30 for workshop and stores.

Arrangements are in progress for the recruitment of a Director for the Road Research Institute and efforts are being made in the United Kingdom,

U. S. A. and other countries to appoint an eminent engineer with suitable road research experience at an early date.

Buildings :

The main Institute is expected to be an imposing two-storeyed structure provided with the most up-to-date fittings and equipments necessary for an institute of this type, and there will be separate buildings for special purposes like stores and experimental station. The main building will contain a general Administrative Block including the Director's office, a Central Library Block which should be the main feature, a cinema hall which could also be used as a lecture theatre, a conference room, an economics and statistics section, a publication, editing, and drawing office block, a photographic section, a canteen and visitor's room, and physical and chemical laboratories. The question of including the soils laboratory and possibly some other laboratories is under examination.

Provision is being made for a technological block to house a workshop, materials, structural and roads section consisting of heavy and light machinery.

The main laboratory is estimated to cover a total floor area of about 35,000 sq. ft. and the technological block will have a floor area of about 24,000 sq. ft.

While designing the institute buildings provision will be made for suitable expansion which may become necessary at a later date.

Garages for motor cars, cycle sheds, a club building and guest house, hostel to accommodate about 50 persons, as also residential accommodation for staff are to be included in the building programme.

Financial implications :

According to tentative estimates already prepared, the cost of the institute including buildings, equipment and services and experimental test tracks will be about Rs. 13.5 lacs and the recurring charges about Rs. 4 lacs per year in the first 5 years, which is expected to increase to Rs. 7.5 lacs after a period of 5 years. Sanction of Government of India has already been obtained for a sum of Rs. 17.5 lacs for establishing the institute. Detailed estimates are being worked out in the light of latest literature recently received from the U. K. and U.S.A.

Building Research Station.

The Council of Scientific and Industrial Research realising the scope for research on the various indigenous building materials available in India and in building research generally, set up a Building Research Committee in December 1943. The Committee consisted of the following personnel :-

1. Sir Teja Singh Malik
2. Prof. P. Ray
3. Dr. A. H. Pandye
4. Mr. D.G.W. Teasdale
5. Rai Bahadur Madan Gopal Sardana (as Principal, Engineering College, Roorkee)
6. Khan Bahadur Mohd. Salaiman
7. Dr. J.M.B. Gibbons
8. Director, Scientific and Industrial Research (*Ex-officio*).

This committee met for the first time in New Delhi on the 5th September 1944 when *inter alia* the committee recommended the setting up of a Building Research Institute. For the establishment of such an Institute, there were two courses, viz., (i) formation of an independent full-fledged institute or (ii) carrying on work on research problems in conjunction with some university or engineering institution. The second alternative was chosen by the committee as an experimental measure, so that in course of time an independent institution may be established by the committee in the light of the experience thus gained.

After making the necessary preliminary enquiries from the various engineering colleges the Council decided that the work should be undertaken at the Thomason College of Engineering, Roorkee, where the necessary facilities for this type of work were already available.

The Thomason College of Engineering undertook to provide the laboratory and other facilities to the unit.

The committee met again in August 1945 to consider various schemes of research received from all over India in response to enquiries sent by the committee. The problems were referred to the proposed Building Research Station to be undertaken in order of priority.

Scope of Work and Functions.

Activities in building industry are two-fold in character; (1) to manufacture materials used in the construction of buildings and (2) to

construct buildings on proper designs to suit particular needs. These two call for team work from scientists of varied qualifications. The Building Research Station would, therefore, house sections from those on the preparation of materials to others engaged on actual construction and tests. Following the British practice, the functions of such a Station should include the following :-

- (1) To examine building materials in common use and the methods of applying them with a view to effecting economics and improvements wherever practicable.
- (2) To examine new materials or processes evolved at the Station or by other workers.
- (3) To diagnose scientifically the causes of difficulties and failures in materials or their application.
- (4) To spread abroad useful information and to foster the growth of scientific spirit and outlook in the Building world."

To these might be added one more on "the determination of standards for materials and workmanship.", for as yet no standards exists in India for building materials.

To help in the achievement of these aims laboratories for the Station should be established.

A detailed plan of the functions of the Building Research Station has been drawn up and is under consideration.

In the meanwhile for the immediate starting of research work three Research Officers and three technical assistants with a nucleus staff of an assistant and a stenographer have been appointed to work under the officer on special duty placed in charge of the Building Research Unit at Roorkee.

Site and Buildings.

The Building Research Unit has been located, for the present, in the Thomason College of Engineering at Roorkee, as it was considered that the college being one of the biggest of its kind in India, the facilities, both in men and material, could be easily drawn upon from the college. The Planning Committee will perhaps have to consider the place best suited for the establishment of a Building Research Station from various considerations, such as : nearness to industries, to building materials, proximity to

a first class civil engineering college etc. Perhaps the climate of the place will also play a good part in the decision.

Central Institute for Drug Research

At the instance of the Pharmaceuticals and Drugs Committee which felt that there was a great and immediate need for organised and coordinated research on natural as well as synthetic drugs in India, Dr. B. Mukerji, Director of the Central Drugs Laboratory, Calcutta drew up a plan. This scheme was elaborately discussed by the committee during 1947 and has been finally modified by the Director, Scientific and Industrial Research. The scheme has also been approved by the Director General, Health Services and the Health Ministry. The proposal has been accepted by the Council of Scientific and Industrial Research and the appointment of an Assistant Director (Planning) and nucleus staff to work out the actual details of the building and construction etc. is expected in the near future.

The functions of the Institute would be promotion of drug research in general, from botanical, chemical, pharmaceutical, pharmacological, micrological & clinical view points; testing and standardization of drugs according to approved or new methods that are likely to be evolved; to offer facilities to industrial institutions in the solution of their problems; and provision of controlled clinical trials in hospitals, clinics etc. The institute to begin with will consist of the following divisions:—

- (1) Chemical
- (2) Pharmacological
- (3) Biochemical and Microbiological
- (4) Clinical

The financial implications of the project are:

Capital	Rs. 20,00,000
Recurring	Rs. 4,50,000

Food Technological Research Institute.

The need for establishing a Food Technological Institute in India was first mooted by the Industrial Research Planning Committee and they recommended that it should come under the central organisation responsible for Scientific and Industrial Research in the country. They also suggested giving a high priority for bringing this institute into being.

The matter was then taken up by the technical panel of the Food Department who had instituted a few schemes of research on certain

immediate problems of storage, preservation, substitutes etc. But it was increasingly felt that the Central Institute should be founded at an early date. The views of the provincial governments were sought and all were agreed on the necessity for a Central Institute. At the instance of the Food Department a plan was prepared by Dr. B. C. Guha and Dr. Bashir Ahmed under the guidance of Sir S. S. Bhatnagar. The Food and Agriculture Ministry are now also agreed to the plan being pushed forward by the Council of Scientific & Industrial Research who has sanctioned the proposal and a nucleus staff for detailed planning is expected to be appointed in the near future. The tentative estimates for the Institute are Rs. 20,00,000 capital and about Rs. 5,00,000 recurring.

Central Leather Research Institute.

The Leather Research Committee of the Board of Scientific & Industrial Research at its 1st meeting held in December 1944 discussed the need for a well equipped Central Leather Research Institute to develop the Indian leather industry along modern lines and to coordinate the work being carried on by the various provincial institutes. A plan prepared by Mr. K. Seshachalam Chowdhury for the Industrial Research Planning Committee was considered suitable as the basis for such an institute. The capital cost would be just over Rs. 18,00,000 and recurring expenses Rs. 5,39,000. The Institute would consist of four sections (1) General & Physical (2) Organic (3) Biochemistry and (4) Analytical, to deal with the various aspects of leather technology.

The plan was tentatively approved by the Council and it was also decided to locate this Institute in Madras as South India was vitally interested in this industry and as the Madras University was already receiving a block grant from the Council of Scientific and Industrial Research towards the maintenance of a leather technological section. During February 1947 the Director, Scientific and Industrial Research visited Madras to select a site in which task he received the cooperation of the authorities in Madras. A site near the Engineering College at Guindy, Madras was selected but the price was rather prohibitive. The Madras Government have now offered to purchase this site and place it at the disposal of the Council free. This offer now awaits the consideration of the Council.

Electro-Chemical Industries Research Laboratory.

A large number of chemicals, metals and alloys are manufactured by electro-chemical and electrothermal processes. Some parts of India

especially the south do not possess sufficient resources of coal and other fuels with the result that the chemical and metallurgical industries there have to be planned on the basis of electric heating.

In view of these facts the Electrochemical Industries Research Committee, as early as 1944 recommended to the Council of Scientific and Industrial Research the immediate establishment of a Central Institute for Electrochemical Research in India. The Industrial Research Planning Committee considered the scheme and recommended its acceptance at an early date.

The Council decided that along with the Leather Research Institute this Institute should also be located in South India either at Madras or Bangalore. At the instance of Shree Rajagopalachari, the then President of the Council, Director, Scientific & Industrial Research visited Madras in 1947 and held discussions with the Madras Government and the University authorities. A site near the Guindy Engineering College was selected as suitable but was discovered to be too costly. Recently the Madras Government has made an offer to place the site at the disposal of the Council free of cost so that the Institute may be located in Madras. The offer now awaits consideration by the Governing Body.

PLANNING OF RESEARCH ORGANISATION.

The labours of the expert laboratory committees planning the various national laboratories, gained in importance and significance from two important developments in recent years. These developments have provided a basis for the comprehensive organisational set up of scientific research in India, of which these national laboratories and—others to follow—would constitute integrated parts.

Prof. A. V. Hill's Report.—The first was the very welcome visit of Prof. A.V. Hill, F.R.S., N.L., M.P., Secretary and official representative of the Royal Society, London, to India, in response to an invitation issued by the Viceroy through the Secretary of State for India, to discuss the organisation of scientific and industrial research as a part of India's post-war reconstruction plan. Prof. Hill came to India in 1943 and after his visit to most of the important research centres and discussions with leading Indian scientists and scientific bodies during his stay of several months in this country, he submitted a valuable report on his findings with certain proposals embodying a most forceful plea for expansion and better coordination of research in India backed by liberal financial assistance from Government.

Of the several important recommendation Prof. Hill has made, special mention must be made of two viz., the establishment of scientific liaison between India and other countries, and the creation of a Central Organisation for scientific research under the Hon'ble Member incharge of the Planning and Development Department of the Government of India, in as much as these recommendations are most intimately connected with the future developments of the existing Council of Scientific and Industrial Research. Deploring the lack of scientific contact between India and other countries, Prof. Hill has very strongly recommended the establishment of Indian Scientific Offices in London and in the United States of America. He has suggested—following a recommendation of the British Commonwealth Science Committee of the Royal Society in favour of permanent scientific representation of English speaking countries in London,—that five specialists should be appointed to the London office to deal with scientific matters relating respectively to agriculture, defence, engineering, industry and medicine. The President of the Royal Society had proposed to the Secretary of State for India that the Society might set up a special committee of Fellows interested in Indian affairs, for the purpose of advising the Indian Scientific Office at the Indian Office, or at the offices of

the High Commissioner for India on any special matters desired. Such advice would have continuity as well as authority, which is more than could be obtained from *ad hoc* committees improvised at intervals for special purposes. The advantage of a scientific office in the U.S.A. are also many, as there are many practical problems, to the solution of which scientific methods can contribute, which are common to India and North America. The recommendation for the establishment of a Central Organisation for scientific research follows very closely similar organisations in the United Kingdom. It is strongly urged that so long as the research organisations of the Central Government remain dispersed under a number of separate departments or bodies most of them having many other serious duties and pre-occupations, it is not possible to evolve a common plan to guide them all in the best interests of the country. If anything at all should be common to India as a whole, surely scientific research can be among the first to claim that common interest. It is, therefore, proposed that all the six main categories of scientific work affecting the welfare of the country, (in addition to the 'pure' academic research lying at the back of each of them) viz., 1. Medicine and Public Health; 2. Agriculture and Animal Husbandry; 3. Industry; 4. Surveys and Natural Resources; 5. Engineering; 6. The Defence Services, must be brought under a single Central Organisation, which will function under the Hon'ble Member for Planning and Development. The following constitutions are recommended for the proposed Central Organisation :—

- (a) Six Research Boards to be set up as the Medical Research Board, the Agricultural Research Board, the Industrial Research Board, the Board of the Surveys and National Resources, the Engineering Research Board and the War Research Board.
- (b) Each Board would have as Chairman an eminent person, either a scientist or a professional man in the field concerned. The Chairman would not be concerned with the detailed administration of the work of their Boards. The Member for Planning and Development would not be Chairman of any of the Boards; the Chairmen would report to him.
- (c) The Members of the Boards would be eminent and experienced scientific men, together with a certain number of professional men in the respective fields; the Boards should be primarily scientific, and the professional men should not outnumber the

scientists, and the purpose being 'research.' There would be a certain number of *ex-officio* members representing development interests.

- (d) The work of the several Boards should be co-ordinated by providing for a sufficient degree of common membership.
- (e) In each subject there should be a Director of Research. He should be a scientific man of high standing. He would be Secretary and Principal Administrative Officer of his own Board and a member *ex-officio* of each of the other Boards. He would be given adequate scientific and administrative assistance. He would be answerable to the Member for Planning and Development and would have the status of a joint or Additional Secretary of an ordinary department.
- (f) The Director would be responsible, with the advice of their Boards and under the Member for Planning and Development, for directing, organising, initiating and co-ordinating research on a nation wide scale so far as constitutional considerations allowed in their respective fields.
- (g) Each Board would appoint Committees dealing with the various aspects of its work ; the chairmen of these Committees would be selected from among members of the Board and would be encouraged to take considerable initiative.
- (h) Joint Committees would be set up between two or more Boards for dealing with special subjects.
- (i) Each Board would have the power to allocate grants for specific researches in its own field to be carried out by agreement in any institutions in India.
- (j) A Research Grants Committee would be set up jointly between the different Boards, to award grants to universities and other laboratories throughout India, for the encouragement of fundamental scientific research in general. If a University grants Committee were set up, these general research grants would be given in consultation with it.
- (k) A Research Studentships Committee would be set up jointly between the different Boards, to consider applications for research

studentships by young workers of proved ability desiring to gain further research experience, particularly in good laboratories abroad.

- (l) All chairmen and members of Boards and committees, apart from official and *ex-officio* members would retire after a period of service to be determined. After a suitable interval they would be eligible for reappointment on suitable terms.
- (m) Each Director of Research would prepare estimates for the work of his Board, which after discussion and approval by the Board would be submitted to the Member for Planning and Development. A Joint Estimates Committee under the Chairmanship of the member or his secretary would compare and co-ordinate the different estimates, before submission to the Finance Department.
- (n) After the estimates have been approved each Board will be able freely to spend the funds at its disposal without further application or argument.

The recommendations also include a proposal for the appointment of a Consultative Committee to advise the Hon'ble Member for Planning and Development on general policy in relation to research, and on any special matters submitted to it. Regarding the constitution of the Committee, it is proposed *inter alia* that it should consist of the six Directors of Research together with six other distinguished scientists, one in each field; and that the latter should not be officials of the Central Scientific Organisation though they could be members of any of its Boards or research workers in its constitution.

On this last recommendation of Prof. Hill action has recently been taken by the Government of India as a measure conducive to planning and co-ordination of research now administered through several departments by setting up a Scientific Consultative Committee with official and non-official members. The official members of the Committee include Master-General of Ordnance, Vice-Chairman, Imperial Council of Agricultural Research or the Agricultural Commissioner to the Government of India; Director-General, Indian Medical Service; Director, Geological Survey of India and the Director of Scientific and Industrial Research. The Committee is now presided over by the Hon'ble Prime Minister as Minister incharge Scientific

Research, with the Minister for Industry and Supply as Vice-President and Director, Scientific and Industrial Research as Secretary.

INDUSTRIAL RESEARCH PLANNING COMMITTEE.

The second important event following close upon Prof. Hill's visit to India and expected to exercise a very great influence on the expansion of scientific and industrial research in India in future relates to the appointment of the Industrial Research Planning Committee early in 1944. This Committee was appointed by the Council to make a comprehensive survey of the existing facilities for scientific and industrial research in India including Indian states, in the universities, research institutions and laboratories attached to industrial and other concerns and to report on necessary means of co-ordination, control and direction and development of such research by various agencies and also on other steps necessary for the planning of such research in post-war India. The personnel of the Committee was as follows :

Sir R.K. Shanmukham Chetty, K.C.I.E.	Chairman
Sir Jhan Chandra Ghosh, D.Sc., F.R.A.S.B.	Member
Lt. Col. S.S. Sokhey, M.D., I.M.S., Director Haffkine Institute, Bombay.	"
Mr. Kasturbhai Lalbhai, Ahmedabad	"
Sir J.J. Ghandy, C.I.E., M.I.E., F. Inst. P., M.I.S.I., Agent, Tata Iron & Steel Co., Ltd., Jamshedpur.	"
Prof. S.K. Mitra, M.B.E., D.Sc., Professor of Physics, Calcutta University, Calcutta	"
Dr. K A. Hamied, M.A., Ph. D., A.I.C., F.C.S. (Lond.), "Cipla" Laboratories, Bombay.	"
Prof. M. Qureshi, M.Sc., Dr. Phil., F.N.I., Head of the Department of Chemistry, Osmania University, Hyderabad (Deccan).	"
Sir S.S. Bhatnagar, O.B.E., D.Sc., F.R.S., Director, Scientific and Industrial Research, Delhi.	"
Mr. J.N. Sen-Gupta, M.B.E., M.A., B.L., Industrial Economist and Research Development Officer of the Council of Scientific and Industrial Research.	Secretary

The Committee surveyed the present day position of scientific and industrial research in the country, mainly on the basis of replies to questionnaires issued to various universities, research institutions and government departments interested in industrial research and also to chambers of commerce and industrial associations; visited several universities and research institutes; and held discussion with eminent scientists and industrialists of many of the leading and representative centres of scientific and industrial research and also representatives of some leading Indian States. Based on the information so collected the Committee has brought out a comprehensive report embodying specific proposals for the development of scientific and industrial research in India on the basis of a 5-year Plan.

The Committee has recommended the establishment by the Government of India, of a central research organisation to be called the National Research Council which should come under the Department of Planning and Development with the Hon'ble Member as the *ex-officio* President. The Government should provide a block grant of Rs. 6 crores to enable the Council to discharge its functions which include the following :—

- (1) To organise and maintain national laboratories.
- (2) To establish and maintain specialised research institutes.
- (3) To stimulate pure and applied research in universities by grants-in-aid and by the institution of scholarships and fellowships.
- (4) To provide for the immediate problem of the dearth of technical and research personnel by the inauguration of scholarships available in India and abroad.
- (5) To stimulate and encourage research activities of all the existing research institutes and departments of government and undertake planning of research programmes on a comprehensive basis.
- (6) To function as a National Trust for Patents.
- (7) To set up a Board of Standards and Specifications.
- (8) To function as a clearing house, encourage deserving scientific and technical societies and foster the growth of new ones in appropriate lines.

The Council should consist of 60 members, of whom 20 members (all scientists) would be elected by all the universities and recognised

scientific associations and academies, 15 members by recognised chambers of commerce and associations of manufacturers and 5 members by recognised trade unions and other labour organisations, the Government would nominate 20 members, of whom not more than 8 including two representatives of the Railway Department may be officials. The Council will be responsible for direction and control of scientific and industrial research and will be constituted for a term of 5 years. The immediate task of the Council will be to make and carry out a five-year plan of research organisations, consisting of (1) the building and equipping of a National Chemical Laboratory and a National Physical Laboratory; (2) the building and equipping of certain specialised research institutes totalling nine viz., Institute of Food Technology, Metallurgical Institute, Fuel Research Institute, Buildings and Roads Institutes, Leather and Tanning Institute, Industrial Fermentation Institute and Electro-chemical Institute; (3) providing grant-in-aid to universities for strengthening and developing their scientific departments and (4) training research personnel for staffing the various national laboratories and specialised research institutes by the award of scholarships tenable in India and abroad.

According to the Committee's estimates the National Chemical and the National Physical Laboratories would involve a cost of Rs. 40 lakhs each. The establishment of all the research laboratories including the nine specialised institutes would involve a total expenditure of about Rs. 2.5 crores. In recognition of the importance of universities as the foundation of all research it is recommended that a sum of about Rs. 2 crores should be set apart for giving them grants-in-aid. The first 5-years plan is to include a provision to train about 700 research workers at an estimated total expenditure of about Rs. 50 lakhs.

As the Council, with its 60 members would be too unwieldy a body to undertake executive and administrative functions, the committee recommended that such functions should be entrusted to a small executive body, to be called the Research Board. The Board, to start with would consist of three full-time members, of whom two should be outstanding scientists and the third an industrialist or administrator of distinction and would be assisted by a full-time Secretary with an efficient secretariat. The Board will be the final and principal executive organ acting under the general direction of the Council. There would be a Budget Committee and a Grants Committee to advise the Council and the Research Board, and also a number of Technical Committees to advise them both on matters relating to research.

The Committee recommends the creation of a National Trust for Patents as a self-contained unit affiliated to the Council for the purpose of holding and exploiting all patents arising out of research financed by the Government, in the best interests of the country, and also patents voluntarily dedicated to it by private individuals or institutions on agreed terms. Similarly, the formation of the Board of Standards has been recommended to draw up Indian Standard Specifications and make necessary arrangements for allied research in the various laboratories set up under the auspices of the Council. It is proposed that the Test House at Alipore should be transferred to the control of the Council and other test houses should be set up to meet regional needs.

The execution of the programme drawn up for the first five years will consume the block grant of Rs. 6 crores. To enable continuity of the Council's activities thereafter it is recommended that the Government should provide an annual grant of Rs. 1 crore to the Council and that the industry of the country should be asked to contribute an equivalent amount to be realised by the levy of statutory cess of 1/16th of one percent on the value of production of industries run on factory basis. Similar contribution is recommended from the gross earnings of railways on the same percentage basis. In view of the paucity of research organisations in India set up by industrial associations on a corporate basis (except in the case of jute and tea)—which provides a striking contrast to the position prevailing in the United Kingdom—the committee recommends, by way of encouraging the development of research associations, a special exemption from cess in cases where the contribution of a firm to an association for research purposes equals or exceeds the amount of the proposed cess. For encouraging research and facilitating the establishments of laboratories by individual firms complete exemption is recommended of the research expenditure incurred by them from income-tax assessment and the committee has made some detailed proposals in this connection for making suitable amendments in the existing income-tax law.

The proposed National Research Council will be an All-India organisation and it is recommended that similar scientific organisations for the promotion of industrial research should be set up in the provinces as well as in the major states.

The reports of Professor Hill and the Industrial Research Planning Committee have been considered by the Scientific Consultative Committee. It has been decided to prepare a scheme for the central organisation of

scientific research on the basis of the proposals contained in both these reports and some other alternative suggestions placed before the Consultative Committee, for submission to Government. Regarding the establishment of some more specialised research institutes, as recommended by the Industrial Research Planning Committee, the Consultative Committee decided that these might await the establishment of the five laboratories already sanctioned; it was, however, recognised that an Institute of Food Technology was essential. The Committee have endorsed the proposal of a cess on industry, as recommended by the Planning Committee, as essentially a sound method of financing research supplemented by an equivalent contribution from Government and have proposed that the method of the collection of the cess should be by a surcharge on income-tax paid by industrial undertakings. The Consultative Committee have also endorsed the recommendations of the Industrial Research Planning Committee in regard to sanction of grants-in-aid to universities, the establishment of a National Trust for Patents and the inauguration of the Board of Standards and Specifications.

FINANCE

The Industrial Research Fund placed at the disposal of the Council, initially for a term of five years commencing from April 1942, receives a non-lapsable annual grant of Rs. 10 lakhs from the Government of India which had been raised to Rs. 15 lakhs for the year 1945-46 by a supplementary grant of Rs. 5 lakhs to meet the additional expenditure entailed by the growing activities of the Council. For 1947-48 the recurring grant has been raised to Rs. 27.36 lakhs. This government grant is the mainstay of the Council's finances. A portion of the Council's income is derived from the receipts of premia and royalties from the lease of its processes to firms for commercial exploitation,—which amounted to a total of about Rs. 1.98 lakhs during the years 1942 to 1947—and also from limited contributions by firms in aid of specific investigations undertaken at their instance at the laboratories of the Council. Such private investigations, however, as already pointed out, had to be suspended temporarily on account of the very limited laboratory facilities available at present and await to be resumed on a much larger scale when the five national laboratories are brought to the working condition with complete equipment. Further in consideration of wider economic interest of the country the Council has very much liberalised its policy for leasing out the processes evolved under its auspices, guided more by the idea of promoting the industrial development of the country than earning a handsome revenue for strengthening its resources, and this has resulted in an appreciable decline in the income of the Council from this particular source. The Journal of the Council which was originally started as a quarterly towards the end of 1942, and has since been converted into a monthly, has been bringing in an increasing income by way of subscriptions and advertisement fees and as against the expenditure involved it is confidently expected to be a self-supporting proposition in the course of the next few years. As it constitutes an important feature of the intelligence service rendered by the Council, no reliance is yet placed on it, even potentially, as a source of net income of any significance.

According to the latest Budget of the Council for 1947-48, the total receipts were estimated at 118.62 lakhs. This includes, 39.39 lakhs unspent balance from last year, lumpsum grant of Rs. 57.36 lakhs (Rs. 30.00 lakhs non-recurring and Rs. 27.36 lakhs recurring). The balance is made up of promised contributions from others, the subscription for the Journal and other miscellaneous items. Out of this Rs. 5.02 lakhs are

provided for research at the Council's Delhi laboratories, Rs. 9.42 lakhs for grants-in-aid to universities and institutes for research and Rs. 1.00 lakhs towards the expenditure of the various Research and *ad hoc* Committees. The Dictionary would involve an expenditure of Rs. 1.26 lakhs, Provision for a capital expenditure of Rs. 77.16 lakhs has been made for the various national laboratories during the year while the recurring expenditure under this head is expected to amount to Rs. 5.51 lakhs.

In regard to the national laboratories which are under construction and planning, the Government of India have sanctioned a capital grant of Rs. 1 crore. In addition, the Council has the following promised donations : Rs. 20 lakhs from the House of Tatas (Rs. 8.30 lakhs for the National Chemical Laboratory and Rs. 11.70 lakhs for the National Metallurgical Laboratory) ; Rs. 1 lakh from the Indian Steel & Wire Products Ltd; Rs. 25,000 from the late Mr. D.P. Khaitan ; and Rs. 10,000 each from the U. P. Glass Manufacturers Association through their President Mr. I. D. Varshney, the Bengal Glass Manufacturers Association through their President Mr. D. N. Sen, and the Metallurgical Society of India and Rs. 10,000 from Dr. U. N. Brahmachari. Further, the Council has received the following gifts of lands : 66 acres from Government of India at Delhi (where the National Physical Laboratory will be set up) and 100 acres from the Rajah of Jharia near Dhanbad which has been chosen as the site for the Fuel Research Institute.

It is estimated that the total cost involved in these laboratories for both capital and recurring expenditure even apart from a few more considered urgent and necessary will exceed the resources available at present at the disposal of the Council. The deficiency, however, can be easily met if, following the instance of the House of Tatas and others, some more contributions are forthcoming from the leading industrial firms in India, both Indian and British, in appreciation of the potential services of scientific research to the economic development of the country and the general improvement of the living standard of the people which provide the very basis of all industrial and commercial activities. Contributions actuated by similar considerations are also expected from the Indian states and wealthy philanthropists. If some handsome donations are available on this account it should be possible for the Council, indeed, to set itself to the task of building a few more essential laboratories in addition to those already sanctioned for which Government may be pleased to provide the additional funds required. India lags far behind the advanced countries of Europe and

America in regard to the organisation of industrial research and an expenditure of crores of rupees would be required even to bring her up to a level comparable to these countries.

Regarding the maintenance cost of the new laboratories in future and such others as may be brought into existence hereafter specific recommendations have been made by the Industrial Research Planning Committee for the levy of cess on industry to be supplemented by an equivalent Government grant. These are estimated to yield Rs. 2 crores annually and should suffice for several years to come. This proposal has, as already stated, been considered and approved in principle by the Scientific Consultative Committee of the Government of India and final decision thereon by the Government is awaited.

APPENDICES

APPENDIX I (A)

GOVERNING BODY

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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Prime Minister of India. President.
2. The Hon'ble Dr. Shyama Prasad Mookerjee,
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Ministry of Industry and Supply. Member.
4. Mr. P.C. Bhattacharya, O.B.E.,
Joint Secretary, Ministry of Finance,
(Industry and Commerce Division),
New Delhi. ”
5. Professor M.N. Saha, F.R.S.,
University College of Science, Calcutta. ”
6. Sir J.C. Ghosh, D.Sc., F.N.I.,
Director General, Industry and Supply,
New Delhi. ”
7. Sir S.S. Bhatnagar, O.B.E., D.Sc., F.R.S.,
Director, Scientific and Industrial Research
and Principal Executive Officer, Council of
Scientific and Industrial Research. ”
8. Sir Shri Ram, 22, Curzon Road, New Delhi. ”
9. Mr. G. L. Mehta
President, Indian Tariff Board, Bombay. ”
10. Professor S. N. Bose,
University College of Science, Calcutta. ”
11. Mr. Kasturbhai Lalbhai
Pankore's Naka, Ahmedabad. ”
12. Sir A.L. Mudaliar, M.D., LL.D., F.R.C.O.G., F.A.C.S.,
Vice-Chancellor, Madras University, Madras. ”

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|-----|---|--------|
| 13. | Dr. S.S. Joshi,
Principal, College of Science, Benares Hindu
University, Benares. | Member |
| 14. | Mr. Frank Anthony,
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| 15. | Sir V.N. Chandavarkar, Bombay. | " |
| 16. | The Hon'ble Sri H. Sitaram Reddy,
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| 17. | Dr. K.A. Hamied, M.A., Ph. D.,
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| 18. | Mr. G.D. Birla, New Delhi. | " |
| 19. | The Hon'ble Mr. N. V. Gadgil,
Minister for Works, Mines and Power, New Delhi. | " |
| 20. | Principal Niranjan Singh,
Sikh National College, Simla. | " |
| 21. | Sir Ardeshir Dalal, K.C.I.E.,
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| 22. | Mr. J.R.D. Tata,
Bombay House, Fort, Bombay. | " |

APPENDIX I (B)

BOARD OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

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and Principal Executive Officer, Council of
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| 5. | Mr. D.N. Sen,
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Calcutta. | " |

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| 17. | Dr. K.A. Hamied, M.A., Ph. D.,
Cipla Laboratories, Bombay. | „ |
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Research, Bombay. | „ |
| 20. | Scientific Adviser to General Headquarters, | „ |
| 21. | Sir C.V. Raman, F.R.S., N.L., Bangalore. | „ |
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| 23. | Dr. J. N. Mukherjee, C. B. E.,
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APPENDIX I (C)
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| 4. | Sir Shri Ram,
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| 5. | Mr. Satya Narain Sinha,
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| 6. | Sir S. S. Bhatnagar O. B. E., D. Sc., F. R. S.,
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Principal Executive Officer, Council of Scientific
and Industrial Research, New Delhi. | „ |

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APPENDIX II.

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Research Assistant
(Temporary)

Mr. Daya Sagar Tandon, M.Sc. (Offg.)

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Technical Assistant.	Mr. N. C. Mazumdar.
Superintendent.	Mr. Nandihal Singh.

National Physical Laboratory.

Director	Sir K. S. Krishnan, F. R. S.
Assistant Director (Planning)	Dr. K. N. Mathur, D. Sc. F. Inst. P.
Engineer.	Mr. D. S. Aggarwal.
Assistant Secretary.	Mr. Gurdev Saran.

National Metallurgical Laboratory.

Assistant Director (Planning)	Mr. G. P. Contractor.
Technical Assistant.	Mr. P. V. Mahajan.
Engineer.	Mr. A. G. Billimoria.

National Fuel Research Institute.

Director.	Dr. J. W. Whittaker, Ph. D., F. R. I. C., M. I. M. in E., M. Inst Fuel
Assistant Director (Planning)	Dr. A. Lahiri.
Chief Engineer.	Mr. A. Lahiri

Central Glass and Ceramics Research Institute.

Officer-in-Charge.	Dr. Atma Ram, D. Sc.
Senior Scientific Officer.	Mr. V. P. Barshney, M.Sc. A.R.I.C.
Junior Scientific Officer.	Mr. R. K. Gobindachari.
Technical Assistant.	Mr. D. P. Mallick.
Technical Assistant.	Mr. P. K. Roy.
Technical Assistant.	Mr. Bh. B. V. J. Rao.
Engineer.	Mr. P. K. Bannerji Chaudhri.

National Road Research Institute.

Assistant Director (Planning).	Dr. R. K. N. Iyengar.
Superintendent.	Mr. R. P. Pathak.

Building Research Unit.

Officer on Special Duty.	Dr. S. Parthasarathy.
Senior Scientific Officer (Chemistry)	Dr. N. K. Patwardhan.
(Physics)	Dr. Gurdas Ram.
(Engineering)	Dr. Dinesh Mohan.
Technical Assistant (Chemistry)	Mr. L. C. Jain.
(Physics)	Mr. A. F. Chhapgar.
(Engineering)	Mr. S. Rama Chandra Rao.

APPENDIX III (A)

**Processes evolved under the auspices of the Council of
Scientific & Industrial Research.**

1. High tension ignition cable testing device for field use.
2. Patching cement for repairing rubber and synthetic rubber tanks.
3. Slushing varnishes for metal tanks for petrol storage, and for rubber, synthetic rubber and laminated tanks for carrying petrol in aircraft.
- *4. Nimbidin, nimbidin emulsion and nimbidin gargle.
- *5. Petrol tank sealing composition.
6. Smoke candles and distress signals for use in land and aerial operations.
- *7. Petrol pump diaphragms proof against petrol, alcohol and their mixtures.
- *8. Non-inflammable water resistant cloth.
9. Furfurol.
10. Substitute hairlock.
- *11. Collapsible tubes.
- *12. Lubricants from vegetable oils and vegetable oil mineral oil blends.
13. Carbon electrodes for dry cells, arc lamps and arc welding.
14. Reclamation and use of perspex.
- *15. Tin lining and seaming compound.
16. Improved hot food containers.
17. Antigas cloth.
18. Vegetable oils as fuels and lubricants.
- *19. Laminated paper boards.
- *20. Air foam solution.
- *21. Bhilawan stoving enamel and allied products.
22. Luminous paints and pigments.
23. Substitutes for glass.
24. Silver and glossy transparent paper.
25. Solid fuel.
26. Oil silks.
- *27. Jute boards.
28. Water proof paint for indianite roofing slabs.
- *29. Cork substitutes.
30. Sulphur.
31. Identity discs.

- ♦32. Treatment of manganese ores for use in dry cell manufacture.
- 33. Stearic and oleic acids.
- 34. Barium chloride.
- 35. Potassium chlorate.
- 36. Dettol type of disinfectants.
- 37. Dye extracts and dyed shades on wool and cotton from the barks of *Terminallia arjuna* and *Butea frondosa*.
- 38. Dye extracts and dyed shades on wool from tamarind seed testa.
- 39. Extracts of annatto dye for colouring vegetable ghee, milk, ice cream, aerated waters and food products in general.
- ♦40. Indigenous moulding powders-S.H.P.
- 41. Vacuum pumps.
- ♦42. Treatment of jute mill bobbins by resin impregnation.
- 43. Atoxyl and carbarsonne.
- 44. Glandular products.
- 45. Potash salts from molasses.
- 46. Calcium gluconate.
- ♦47. Small carbon electrodes.
- 48. Carbon and graphite electrodes.
- ♦49. Benzidine.
- ♦50. Para-amino phenol.
- 51. Radio resistances.
- ♦52. Drawn laminated mouldings.
- 53. "Beemax" like products.
- 54. Yeast extracts.
- ♦55. Welding flux for aluminium and its alloys.
- 56. Photosensitising dyestuffs.
- 57. Photographic plates and paper.
- 58. Porcelain containers for hydrogen peroxide
- ♦59. Water detecting composition.
- ♦60. Duplicating ink.
- 61. Organo-arsenical compounds.
- 62. Titanium dioxide from ilmenite.
- 63. Mosquito repellent cream.
- ♦64. Bhilawan air drying varnishes etc.
- 65. Total alkaloids from *datura* seeds.
- 66. Flux coated steel electrodes.
- ♦67. Ebonite substitute and other hard and soft rubber goods from rubber waste.

68. Shark liver oil.
69. Fertilizers from phosphatic nodules.
70. Phosphorus from phosphatic nodules.
71. Treatment of bamboo reeds for use on handlooms.
72. Water proofing compound for cement mortars.
- *73. Butter paper.
74. Coffee bean and husk plastics.
75. Substitute for gramophone metallic needles.
- *76. Urea.
- *77. Hydraulic brake fluid.
78. Nitrobenzene, aniline and dimethylaniline.
79. Formaldehyde.
80. Solid metal polish.
81. Petrol hose pipes.
82. Zinc salts from waste zinc slimes.
83. Pyrethrum emulsifier.
84. Aniline from chlorobenzene.
85. Clay pigeons.
- *86. Sintered glassware.
87. Compression and injection moulding powders from bhilawan shell liquid.
88. Bonding of plywood from indigeneous raw materials.
89. Carbon microphones.
90. Loud speakers.
91. Rubber sponges.
92. Manufacture of straw boards from various grasses.
93. Copper silicon bronze.
94. X-Ray transformers.
95. Concentrated extracts of pyrethrum.
96. Manufacture of enterovioform.
97. Manufacture of butanol and acetone.
98. A sealing composition and method for sealing holes in metallic or other sheets, containers or the like.
99. Dipped latex material.

APPENDIX III (B).

Processes evolved under the auspices of the Council of Scientific and Industrial Research and transferred to Supply Development Committee (S.D.C.) Royal Air Force, etc., for development.

Process	Transferred to	State of Utilisation
1. High tension ignition cable testing device for field use.	R. A. F.	Being utilised by R. A. F.
2. Slushing varnishes for metal tanks for petrol storage, and for rubber, sythetic rubber and laminated tanks for carrying petrol in aircraft.	R. A. F. and U.S.A.A.F.	Being utilised by R. A. F. and U. S. A. A. F.
3. Patching cement for repairing rubber and synthetic rubber tanks.	—do—	Being utilised by R. A. F. and U. S. A. A. F.
4. Petrol proof hose pipes	R. A. F.	The process has since been retransferred to the Council for exploitation for civilian purposes.
5. Petrol pump diaphragms proof against petrol, alcohol and mixtures.	R. A. F. and S. D. C.	Being utilised to meet both civilian and military demands.
6. Petrol tank sealing composition	R. A. F.	Full details of the process have been communicated for use to the R. A. F.
7. Smoke candles and distress signals for use in land and aerial operations.	R. A. F. and S. D. C.	Ordnance factories have been entrusted with manufacture.
8. Reclamation and use of perspex.	—do—	The details of the process have been handed over to S. D. C. for utilisation.
9. Non-inflammable water resistant cloth	S. D. C.	The details of the process have been handed over to S. D. C. The process has now been retransferred to the Council for exploitation for civilian purposes.

Process	Transferred to	State of Utilisation
10. Substitute hairlock.	S. D. C.	The details of the process have been handed over to S. D. C.
11. Improved hot food containers	—do—	The details of the process have been handed over to S. D. C. who have since drawn up the specifications.
12. Furfurol	—do—	Released free-of-charge to help utilization of wastes from the rice and starch industries in the country.
13. Plastic collapsible tubes	—do—	The process has since been re-transferred to the Council
14. Lubricants from vegetable oils and vegetable oil mineral oil blends.	—do—	Released free of charge. Messrs. Burmah Shell are already exploiting the process. Numerous other firms have been supplied with necessary information.
15. Carbon electrodes for dry cells, arc lamps and arc welding.	—do—	Since retransferred to the Council. The Estrella Batteries Ltd., Bombay have been entrusted with the manufacture of small electrodes. The Aluminium Corporation of India Ltd., Asansol and a Travancore firm have being entrusted with the manufacture of big electrodes.
16. Tin lining and seaming compound.	Food Department	The process is now being leased out for commercial exploitation to private concerns.
17. Water detecting composition	R. A. F.	Specifications have been drawn up by the Ordnance Laboratories, Kanpur and the S. D. C. for its development.
18. Pyrethrum cream	D. G. I. M. S.	The manufacture was undertaken by D.G.I.M.S.
19. Manufacture of pyrethrum emulsifier		The processes have now been retransferred to the Council.

Process	Transferred to	State of Utilisation
20. Thickened fuel for flame throwers and incendiary bombs.	S. D. C.	A satisfactory substitute for aluminium stearate has been developed and the results have been communicated to S. D. C. with whom the question of utilisation is under consideration. The thickened fuel has been found to be satisfactory.
21. Anti-gas cloth	Supply Department	The process has been leased out to various firms in the country free-of-charge. The firms are now in regular production.
22. Treatment of aviation fuel for reducing the vapour lock tendency.	R. A. F.	The results have been communicated to R. A. F. for utilisation.
23. Cellulose dopes	Supply Department	Being utilised by the Supply Department.
24. Clay pigeons	R. A. F.	The material has been approved by the R. A. F. who are developing the process.
25. Hydraulic brake fluid	S. D. C.	Leased out for commercial exploitation to the Indo-Burma Petroleum Co. Ltd., Bombay.

APPENDIX III (C)

Processes released free of cost for civilian use.

I. Antigas Cloth

The process was utilised by the following 19 firms :—

1. M/S. Adoni Proofing Co., Alur Road, Adoni (M.S.M. Rly).
2. M/S. A.A. Karim Bros., C/o Ahmed Oil Leather Cloth Factory, Ambernath (G.I.P. Rly) Bombay No. 9.
3. M/S. Antigas Fabrics Co., C/o Cotton Mills Estate Kalachawk Road, Bombay.
4. Baroda Antigas Co., C/o Shri Yamuna Mills, Goya Gate, Baroda.
5. M/S. Billimora Gas Proofing Co., C/o Gaikwar Mills Ltd., Billimora.
6. Bombay Waterproofing & Dressing Co., Khashinath Dhuru Road, Off Cadell Road, Agar Bazar, Dadar, Bombay.
7. The Loco & Carriage Superintendent, Bikaner State Rly., Bikaner.
8. M/S. New Era Textile Mills Ltd., Tulsi Pipe Road, Bombay 16.
9. M/S. Pearl Fabrics Ltd., Modern Mills Compound, Opp. Jacob Circle, Bombay 11.
10. M. S. Vasant Vijaya Mills Ltd., 170-71 Worli Road, Bombay 18.
11. M/S. Valian Industries, Admedabad.
12. United Iron & Engineering Works, Bombay.
13. M/S. Pannalal Antigas Fabrics Factory, 1727, Gunj Bazar, Secundrabad (Deccan).
14. Kesoram Cotton Mills Ltd., 42, Garden Road, Calcutta.
15. Vikram Mills Ltd., Post Railwaypura, Ahmedabad.
16. Binod Mills Co. Ltd., Ujjain (Gwalior State).
17. M/S. Buckingham Carnatic Mills, P. O. Box No 66, Madras.

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|--|--|
| 2. Vegetable oil blends as lubricants | 18. The Rohit Mills Ltd., Railwaypura Post, Ahmedabad.
19. I.R. Swarup & Co., Dilshad, Delhi-Shahdara.
The process has been given free to all parties interested in commercial exploitation. |
| 3. Bamboo record needles. | Do do |
| 4. Coffee husk plastics | Do do |
| 5. Fertilizers from phosphatic nodules. | Revealed to Madras and Bihar Governments. |
| 6. Urea | Revealed to Mysore Government for commercial exploitation at Bhadravati. |
| 7. Mosquito repellent cream. | To be revealed free of cost to all parties interested in commercial exploitation. |
| 8. Signal smokes and flares. | Revealed to the Defence Services suppliers |
| 9. Manufacture of enterovioform. | Released to all interested parties free of charge. |
| 10. Purification of Indian glass sands | This process has been revealed to all interested industrialists. |
| 11. Manufacture of agar agar | The process has been revealed to the Director Research, University of Travancore for commercial exploitation. |
| 12. Standardised filter papers for gas purity tests. | Adopted at all Test Stations in India. |
| 13. Bamboo strips for weaving combs. | Released to Principal, Government Textile Institute, Madras. |
| 14. Capping cement for electric bulbs. | Released to Indian lamp manufacturers. |
| 15. Recovery of titanium dioxide from bauxite sludges. | Results published in the Journal of Scientific and Industrial Research. |

APPENDIX III (D)

Review of Processes leased out for Commercial Exploitation.

1. *Air Foam Solution.* The process which was leased out to Messrs. Fire-Extinguisher Corporation, Calcutta was for production of air foam solution which is used to put out large scale fires, particularly fires to petrol and oil tanks and installations. Due to conditions created by the war, the oil installations in various parts of India were liable to air attacks and to prevent the resultant loss large quantities of this store were required. The Supply Department consequently made the process available to firms other than the Council's licensee and arranged supplies of large quantities of the store. With the termination of the war, the heavy demand for the store no longer exists but it is believed that small demands will continue in peace time also.

2. *Bhilawan Stoving Enamel and Allied Products.* This has been one of the productive processes developed by the Council and the licensees, Messrs. Jay Engineering Works, Calcutta continue to be in production.

3. *Glass Substitutes.* This process was developed to meet the exigencies of war and the licensees, Messrs. Indian Glass Substitute Co., Simbhaoli produced 2.5 million sq. feet of the store. The immediate demand for the store no longer exists but it is believed that when the production of synthetic resins is established in India after some time and supplies of suitable quality wire mesh are available in plenty, production of suitable qualities of glass substitutes to compete with similar foreign products will be possible and the process could then be revived.

4. *Identity Discs.* The process for the manufacture of this store never reached the stage of commercial production as the demand was withdrawn before development could be completed. The process may be considered as abandoned as it is not believed that non-metallic identity discs will find favour during peace time.

5. *Jute Boards.* It has not been possible for the licensees of this process, Messrs. Karam Chand Thaper & Bros., Ltd., Calcutta and Messrs. Juggilal Kamalpat, Kanpur to proceed with development for want of the necessary equipment. Heavy hydraulic presses with large platters of about 4 ft. x 8 ft. dimension are needed and it has not been possible to get these from abroad so far. Till this equipment is imported, there is little likli-

hood of the development of the process on a commercial scale. In the meantime the Council is contemplating further investigations to improve the quality of the product and bring it up to the standard of similar foreign material.

6. *Laminated Paper Fibre Boards.* The production of paper fibre boards has declined with the termination of the war and increased imports of vulcanised fibre boards from foreign countries. The Council is, however, developing a new process for the manufacture of vulcanised fibre boards so as to be able to revive the process.

7. *Luminous Paints and Pigments.* This was essentially a war time store and the quantities required in peace time are of a very small order.

8. *Oil Silks.* The firm has been unable to start production due to the scarcity of silk. The position regarding silk is expected to improve and the licensees are being asked to take up the exploitation of the process in right earnest.

9. *Potassium Chlorate.* This process had been leased out to Messrs. Mettur Chemical & Industrial Corporation Ltd., Mettur Dam who manufactured the store for 3 years but then suspended production as according to them the control price of potassium chlorate was low. The economics of the process have been examined carefully and it is believed that the process can be economical if based on a reasonable price of chlorine. In view of the fact that large quantities of chlorine are expected to be surplus in the near future following the establishment of the alkali industry in India, it is believed that this indirect process will be adopted by some industrialists. The Industrial Liaison Committee has recently decided to cancel the licence of Messrs. Mettur Chemical & Industrial Corporation and make the process available to all interested parties.

10. *Plastic Collapsible Tubes.* These tubes were developed to meet the shortage of tin and lead tubes. In view of the supplies of metal tubes being now available, the need for plastic collapsible tubes has disappeared and no development of the process is expected.

11. *Silver Glossy and Transparent Paper.* This was a war time problem which could not be developed for want of the proper quality paper in the country. When supplies of the right type of paper, 100% pulp, are available in plenty, the further development and improvement of the process can be considered.

12. *Small Carbon Electrodes.* The firm to whom the process was leased out, Messrs. Estrella Batteries Ltd., Bombay, have so far been carrying on production on a small scale. They have now imported the machinery for large scale production and a technical expert of the Council has just visited the firm to assess the technical help needed by the firm to start their plant. It is anticipated that this process will soon be developed to meet a major portion of the country's requirements.

13. *Solid Fuel.* The product had a large war time demand and the Supply Department entrusted several firms besides the licensee, with the supplies. Peace time requirements are not so heavy but a market for the product has been created and it has come to stay as a permanent item.

14. *Stearic and Oleic Acids.* Full production has not been possible as the raw materials are generally not available and when available the price is sometimes prohibitive. It is hoped that when the raw material position eases, full production will be ensured by the licensees.

15. *Cork Substitutes.* One of the two licensees did get into production but unfortunately the firm has gone into liquidation. The other is finding difficulty in procuring the equipment, and when this is available, will arrange production. They are keen on developing the process.

16. *Treatment of Manganese ore for Dry Cell Manufacture.* The process is being utilised by the licensee along with the process for the manufacture of small carbon electrodes. It is anticipated that with the stepping up of the production of small electrodes, production of manganese dioxide will also increase.

17. *Water-proof Paint for Indianite Roofing Slabs.* With the delay in the development of the process, the licensee appears to have lost interest in it. The question of ensuring development, if necessary, by leasing it to other firms also is being examined.

18. *Formaldehyde.* The process was developed on a small scale by the Indian Institute of Science, Bangalore but production was stopped in October 1943. The question of further exploitation of the process is under examination.

19. *Petrol Pump Diaphragms.* This process was developed to meet war time demands and with the cessation of hostilities, the demand has decreased also. The superiority of the product is, however, recognised and the licensee is making efforts to find a civilian market for the product.

20. *Indigenous Moulding Powder S.H.P.* The agreement is under cancellation and the release of the process to other parties is expected to be considered shortly.

21. *Vacuum Pumps.* The production of vacuum pumps requires a good workshop fitted with precision machinery. The two licensees who took over the process are awaiting the plant before attempting to produce the pumps.

22. *Dye Extracts and Dye Shades on Wool and Cotton from Terminalia Arjuna and Butea Frondosa.*

23. *Dye Extracts and Dye Shades on Wool from Tamarind Seed Testa.* These two processes were leased out to Messrs. Howrah Trading Co., Calcutta. They are, however, anticipating certain technical difficulties and do not appear to be interested in the process. With the termination of the war, the supply position of dyes has improved. The details of the process are, however, being re-examined with a view to ensuring production.

24. *Anatto Dye Extracts.* Messrs. Dairy Products and Equipment Manufacturing Co. Ltd., Amritsar to whom the process had been leased out, have been wound up. The question of leasing out the process to other parties is being examined.

25. *Atoxyl and Carbarstone.* The firm to whom the process had been released, Messrs. Zandu Pharmaceutical Works Ltd., Bombay have not been able to undertake production due to the non-availability of the necessary equipment.

26. *Dettol Type of Disinfectants.* This process was leased out to Messrs. Bengal Chemical & Pharmaceutical Works Ltd., Calcutta who are producing the store under a trade name. Since then, the details of the process have been incorporated in the British Pharmacopoea and it is possible that other firms may have started production also.

27. *Resin Impregnation of Jute Mill Bobbins.* The licensees are feeling difficulty in equipment and availability of suitable timber needed for the production of these improved jute mill bobbins.

28. *Extraction of Potash Salts from Molasses.* Full details of the process along with blue prints of the furnace design have been made available to the licensees but they have not yet been able to set up their furnaces and production has not yet started.

29. *Calcium Gluconate.* Messrs. Gluconate Ltd., Calcutta to whom the process was released have been handicapped in stepping up production due to non-availability of stainless steel plant. They are trying to import this from abroad and when this is received, production can be expected to increase.

30. *Carbon and Graphite Electrodes.* It has not been possible to ensure production for this process as the investigator, Mr. Bhandarkar has floated a company of his own and has not made the full technical details available to the licensee. The Industrial Liaison Committee has recently considered the matter and the firm has been assured of technical assistance and further investigation, if necessary, in the Delhi laboratories of the Council of Scientific and Industrial Research.

31. *Butter Paper.* Dr. Hamid to whom the process has been leased has evinced no interest in developing the process and the question of releasing it to other firms is being taken up. The paper difficulty is, however, expected to retard progress.

32. *Tin Lining Compounds.* This process had been leased out to Messrs. Renderian Rubber & Chemical Works, Delhi and the details of the process released to them. The process, however, needed improvement in cutting short some of the complicated steps and the samples, from this revised investigation are now being tested.

33. *Hydraulic Brake Fluids.* Messrs. Indo-Burma Petroleum Co., Ltd., Bombay to whom this process had been leased out developed the process and the store is in the market.

34. *Ebonite Substitutes.* This was a war time problem created by acute shortage of rubber. With the easing of the rubber position, the possibility of commercial utilization of this process has receded.

35. *Solid Metal Polish.* The process was only recently released and the firm had not had time to get into production before the riots stepped in.

36. *Resin and Plasticiser Dopes.* This process has had an unfortunate fate. The process was developed to meet war time needs and before its release could be arranged, the Supply Department had entrusted production to two other firms. The licensee could not ensure production due to difficulties of raw material.

37. *Steam-proof Plastics.* This process was leased out to a Sialkot firm but as they did not evince any interest in development the agreement was cancelled. Further action is under consideration.

38. *Crown Cork Cement.* This was a case of solving the difficulties experienced by a local firm and the details were released as technical advice.

- 39. *Utilisation of Nim Oil and its Bitter Constituents.*
- 40. *Sintered Glass Filters.*
- 41. *Rubber Sponges.*
- 42. *Dipper Latex Goods.*

All these processes have been released very recently and it will be some little time before production can be established.

APPENDIX IV
LIST OF COUNCIL'S PATENTS
(including pending applications)

Serial No.	Indian Patent No.	Whether sealed or pending	Title	Applicants.
1.	27714	Sealed	Process for Improving the mechanical and physical properties of wood.	S. S. Bhatnagar, L. C. Verman, S. M. Karim and G. D. Joglekar.
2.	27715	„	Improved Process for the production of Lubricating Oils.	J. S. Aggarwal, H. D. Chowdhury and L. C. Verman.
3.	28002	„	A Process for the Conversion of Bhilawan Shell Liquid.	S. Siddiqui and S. K. Ranganathan.
4.	28003	„	A Process for the Conversion of Bhilawan Shell Liquid.	S. Siddiqui and S. K. Ranganathan.
5.	28004	„	A Process for the Conversion of Bhilawan Shell Liquid.	S. Siddiqui and Azhar Ali Khan.
6.	28005	„	A Process for the conversion of Bhilawan Shell Liquid.	S. Siddiqui and Azhar Ali Khan.
7.	28135	„	A Process for the Preparation of Depolarising Agent for Dry Cells.	K. Subbaramiah and L. C. Verman.
8.	28277	„	Improvements in or relating to Laminated Boards.	S. S. Bhatnagar, C. A. R. Khan and L. C. Verman.
9.	28281	„	Improvements in or relating to Laminated Corrugated Boards.	S. S. Bhatnagar, C. A. R. Khan and L. C. Verman.
10.	28306	„	Improvements in Plastic compositions.	S. S. Bhatnagar and Ali Ahmad.
11.	28307	„	A method of preparing a rubber composition for manufacturing artificial cork, stoppers, refrigerator pads, insulating materials and like substances, and the substances so manufactured.	S. S. Bhatnagar and Ali Ahmad.

Serial No.	Indian Patent No.	Whether sealed or pending.	Title.	Applicants.
12.	28376	Sealed	Improvements in or relating to the degradation of proteinous materials.	Atma Ram, S. S. Bhatnagar, and Karimullah.
13.	28424	„	Process for the conversion of cashew nut shell liquid to a drying product for the manufacture of lacquer varnishes, stoving enamels, water-proofing, electric insulating and plastic compositions, and like materials.	S. Siddiqui and Azhar Ali Khan.
14.	28427	„	Improvements in or relating to the containers, receptacles, utensils and the like.	S. S. Bhatnagar, Prem Prakash and L. C. Verman.
15.	28428	„	A process for obtaining resin from agricultural wastes such as bagasse and jute wastes, and the resin so obtained.	S. S. Bhatnagar, Prakash Narain and G. S. Tiwari.
16.	28563	„	A process for the transformation of castor oil gel into a soluble viscous liquid.	S. K. Ranganathan and S. Siddiqui.
17.	28974	„	Improvements in or relating to the degradation of proteinous materials.	Atma Ram, S. S. Bhatnagar, Karimullah.
18.	28990	„	Duplicating inks.	Miss S. Ram.
19.	29051	„	Modification of a process for the conversion of bhilawan shell liquid to a non-vesicating drying product for the manufacture of lacquer varnishes, stoving enamels, water-proofing, electric insulating and plastic compositions, or like materials.	S. Siddiqui and Azhar Ali Khan.
20.	29128	„	A collapsible tube or the like containers and a method of making the same.	S. S. Bhatnagar and Prem Prakash.

Serial No.	Indian Patent No.	Whether sealed or pending.	Title.	Applicants.
21.	29155	Sealed	A process for the reclamation of rubber wastes for producing substitutes of hard and soft rubber, vulcanite, ebonite, and composite moulding powders, adhesives, impregnating solutions and like products.	S. Siddiqui and Azhar Ali Khan.
22.	29374	"	Process and plant for the manufacture of phthalic anhydride.	S. S. Bhatnagar and N. Ghatak.
23.	29400	"	Padding materials from cocconut coir.	Ali Ahmad, Vidya Sagar Bhatia and S. S. Bhatnagar.
24.	29412	"	Improvements in or relating to fluids used in hydraulic mechanism.	J. S. Aggarwal, S. S. Bhatnagar and L. C. Verma.
25.	29842	"	Water detecting composition.	Atma Ram, Flight Lieut. Cecil V. Lezard and Mulk Raj Verma.
26.	29938	"	A process for the conversion of bhilawan shell liquid to a nonvesicating drying product for the manufacture of lacquer varnishes, stoving enamels, water proofing, electric insulating and plastic compositions or like materials.	S. Siddiqui and Azhar Ali Khan.
27.	29939	"	Improvements in or relating to rendering textile fabric non-inflammable and water resistant.	Atma Ram, S. S. Bhatnagar, Karimullah and C.A.R. Khan.
28.	29940	"	Improvements in or relating to rendering textile fabric non-inflammable and water resistant.	Atma Ram, S. S. Bhatnagar, Karimullah and C.A.R. Khan.
29.	29966	"	Preparation of resinous materials from the milky juice of plant <i>Euphorbia Tirucalli</i> .	Atma Ram, S. S. Bhatnagar, Karimullah and George Choet Smith.

Serial No.	Indian Patent No.	Whether sealed or pending	Title.	Applicants.
30.	29967	Sealed	A process and apparatus for the production of ammonium carbamate.	J. C. Ghosh and B. S. Kulkarni.
31.	29968	"	Water-proof and gas-proof fabrics from castor oil products.	M. Qureshi and T.V. Subha Rao.
32.	29969	"	An apparatus for the production of urea. (Patent of addition)	J. C. Ghosh and B.S. Kulkarni.
33.	30072	"	An ice bag or like container and a method of making the same.	S. S. Bhatnagar and Prem Prakash.
34.	30196	"	A method of and composition for lining and seaming containers.	S. S. Bhatnagar and Karimullah.
35.	30316	"	Cold moulding composition for the manufacture of moisture resistant or insulating articles such as boards, switches, bottle-caps, trays, panels for radio receiving sets or the like.	M. Qureshi and Mohd Abdul Rahim Khan.
36.	30451	"	A process for the manufacture of sintered glassware.	B. V. J. Janakirama Rao.
37.	30502	"	An improved process of the degradation of keratinous materials or the like.	S. S. Bhatnagar and L. C. Verman.
38.	30503	"	An improved pencil eraser.	M. Qureshi and M.A.R. Khan.
39.	30679	"	Improvements in or relating to the production of foam generating substances.	S. S. Bhatnagar, Atma Ram, A. Jogarao, Karimullah and L.C.Verman.
40.	30680	"	Improvements in or relating to the manufacture of containers, receptacles, hollowware or the like from resin impregnated lamination.	S. S. Bhatnagar, A. R. Khan and L. C. Verman.
41.	31282	"	Improvements in or relating to the manufacture of moulding powders.	S. S. Bhatnagar, A. Jogarao and L. C. Verman.

Serial No.	Indian Patent No.	Whether sealed or pending	Title	Application
42.	31283	Sealed	A sealing composition and method for sealing holes in metallic or other sheets, containers or the like.	Atma Ram, S. S. Bhatnagar and Mulk Raj Verma.
43.	31284	"	Varnish from castor oil products.	M. Qureshi and T. V. Subha Rao.
44.	31510	"	Improvements in or relating to the grinding and utilisation of mica.	Ramesh Chandra Ray.
45.	31511	"	Improvements in or relating to the grinding and utilisation of mica.	Ramesh Chandra Ray.
46.	31594	"	Anthraquinone vat dyestuffs.	V.V. Gokhale and K. R. Venkataraman.
47.	31595	"	Improvements in or relating to rendering paper water-proof greaseproof and non-porous.	Karimullah, G.S. Tiwari.
48.	31877	"	Improvements in or relating to the manufacture of flux compositions for aluminium or its alloys.	S. S. Bhatnagar and A. L. S. Rao.
49.	32237	"	Improvements in or relating to the expulsion of the shell liquid from bhilawan or cashew nuts.	S. Siddiqui and Azhar Ali Khan.
50.	32352	"	Improvements in extraction of rubber from <i>cryptostegia</i> .	S. S. Bhatnagar, Karimullah and Uma Shanker.
51.	32486	"	Improvements in or relating to the manufacture of benzidine.	B. B. Dey, T. R. Govindachari, and S. S. Rajagopalane.
52.	32823	"	Improvements in the production of raised patterns or lettering on the surface of plastic products.	B. N. Sikka, Gurbax Singh, L. C. Verman.
53.	32824	"	Manufacture of containers from resin impregnated lamination.	B. N. Sikka, Gurbax Singh and L. C. Verman.
54.	32834	"	Improvements in or relating to the manufacture of mica incorporated boards, slabs, tiles, or the like (cement mica composition).	R. C. Ray.

Serial No.	Indian Patent No.	Whether sealed or pending.	Title.	Applicants.
55.	32969	Sealed	Improvements in or relating to the manufacture of paints from mica.	R. C. Ray.
55.	32970	„	Improvements in or relating to electro-deposition of rubber (rubber lined equipment).	J. C. Ghosh and George T. Verghese.
57.	32971	„	Extraction of rubber from <i>cryptostegia</i> leaves.	S. S. Bhatnagar, Karimullah and Uma Shankar.
58.	33058	„	Improvements in or relating to rubber lining of non-conducting surfaces.	J. C. Ghosh.
59.	33059	„	Gas cleaning devices for use in conjunction with producer gas plant.	S. K. Dass Gupta, Mohan Lal Khanna, K. K. Achuthan Nair and L. C. Verman.
60.	33077	„	Improvements in the manufacture of plastic composition from pulverised mica (glycerine geletine mica gel).	R. C. Ray.
61.	33078	„	Improvements in the manufacture of para-amino phenol.	B. B. Dey, T. R. Govindachari and S. C. Rajgopalane.
62.	33114	„	Improvements in or relating to the manufacture of paints from mica No. 2.	R. C. Ray.
63.	33115	„	Improvements in or relating to the rubber lining of metallic equipment.	J. C. Ghosh and George T. Verghese.
64.	33261	Accepted	Improvements in or relating to the production of stabilised diazo salts.	R. J. Monalim and K. Venkataraman.
65.	33473	„	Improvements in or relating to the production of nitro derivatives of phenyl ethers.	B. B. Dey, T. R. Govindachari and H. V. Udupa.
66.	33649	Sealed	Isolation of bitter principles from nim oil and from one another.	S. Siddiqui and C. R. Mitra.
67.	33650	„	Separation of the bitter principles from nim oil and simultaneous purification of the oil (nim-1).	S. Siddiqui and C. R. Mitra.

Serial No.	Indian Patent No.	Whether sealed or pending.	Title.	Applicants.
68.	33651	Sealed	New derivatives from bitter principles of nim oil.	S. Siddiqui and C. R. Mitra.
69.	33786	"	Improvements in the working life of jute or cotton mill bobbins, textile shuttles or the like mill accessories.	S. S. Bhatnagar, L. C. Verman, S. M. Karim and A. N. Nayar.
70.	33787	Accepted	A method of adjusting watches and time pieces.	L. C. Verman.
71.	34040	"	Improvements in or relating to containers of the cigarette case type.	Gurbax Singh and L. C. Verman.
72.	34210	Sealed	Improvements in or relating to anthra quinone acid dyestuffs.	S. G. Bedekar and K. Venkataraman.
73.	34211	Accepted	Manufacture of 2 : 4 dichloro-1-amino Anthraquinone.	K. Venkataraman and S. G. Bedekar.
74.	34410	"	Manufacture of mosquito-repellant cream	S. Siddiqui and C. R. Mitra.
75.	34411	"	Conversion of nitro chloro-benzenes.	B. B. Dey, H. V. Upuda, T. R. Govindachari.
76.	34692	"	Improvements in or relating to air seperators.	G. D. Joglekar.
77.	34754	"	An improved process for the conversion of ortho and para nitro chloro benzenes to the corresponding nitro anisoles and nitro phenetoles.	B. B. Dey, H. V. Udupa, T. R. Govindachari.
78.	34755	"	An improved process for the preparation of 2 nitro, 4 chloro phenetoles.	B. B. Dey, H. V. Udupa, T. R. Govindachari.
79.	34756	"	An improved process for the production of ortho dichloro benzidine (3,3' dichloro 4,4' diamino diphenyl.)	B. B. Dey, T. R. Govindachari and S. G. Rajgopalane.
80.	34757	"	Process for the production of 3,6,3',6' tetra chloro benzidine.	B. B. Dey, T. R. Govindachari and S. G. Rajgopalane.

Serial SNo.	Indian Patent No.	Whether sealed or pending	Title	Applicants.
81.	34766	Accepted	Improvements in or relating to magnetic separators.	G. D. Joglekar and L. C. Verman.
82.	34873	"	Improved apparatus for expulsion of bhilawan shell liquid.	S. Siddiqui and Azhar Ali Khan.
83.	34937	"	Improvements in or relating to coating composition for card board containers.	S. M. Karim and K. K. Sarin.
84.	34938	"	Improvements in or relating to the depolymerisation of rubber.	S. Siddiqui, Azhar Ali Khan and B. C. Majumdar.
85.	35328	Filed	An improved method for the production of 2-4 diamino phenol.	B. B. Dey, H. V. Udupa and T. R. Govindachari.
86.	35331	"	Manufacture of rubber sponges.	Azhar Ali Khan, B. C. Majumdar and S. Siddiqui.
87.	35336	Accepted	Improvements in or relating to food containers made of paper, card board or fabric.	S. M. Karim and K. K. Sarin.
88.	35337	Filed	Improvements in or relating to card board containers for rendering them suitable for packing non-alkali watery solutions, inks or the like.	K. K. Sarin and S. M. Karim.
89.	35338	"	Improvements in or relating to the manufacture of concentrated extract of pyrethrum.	S. Siddiqui and A. V. Subharatnam.
90.	35567	"	Improvements in or relating to preventing the deterioration of pyrethrins and preserving the biological stability of pyrethrum preparations.	S. Siddiqui, A. V. Subharatnam and Vishwa Nath Sharma.
91.	35646	"	An improved air cleaning and crank case ventilation system for internal combustion engines.	N. A. Nair and L. C. Verman.

Serial No.	Indian Patent No.	Whether sealed or pending	Title.	Applicants.
92.	36073	Filed	Improvements in or relating to the production of cyclised rubber.	Karimullah and Uma Shankar.
93.	36074	"	Improvements in or relating to the production of chlorinated rubber.	Karimullah and Uma Shankar.
94.	36162	"	Improvements in or relating to the lathes particularly suited for glass working.	Atma Ram, Y. P. Varshney and B. V. Janki Rama Rao.
95.	36163	"	Improvements in or relating to the manufacture of double walled or multi-walled glass flasks such as vacuum or thermos flasks.	Atma Ram, Y. P. Varshney and B. V. Janki Rama Rao.
96.	36182	"	Improvements in or relating to the manufacture of tin free alloys possessing physical and chemical properties similar to tin bearing alloys.	D. R. Malhotra, B. D. Aggarwal and Braham Prakash.
97.	36318	"	Improvements in or relating to the manufacture of rubber compounds for lining or sealing containers for the manufacture of dipped goods or the like.	Karimullah and Uma Shankar.
98.	37155	"	Improvements in or relating to the preparation of aluminium alloys.	D. Sarup, V.G. Iyer and S. Rama Murthy.
99.	37566	"	An improved method for the production of 2,4 diamino phenol.	B. B. Dey, B. R. Pai and H.V. Udupa.
100.	38062	"	Improvements in or relating to the conversion of bhilawan shell liquid to a non-vasicating drying product for the manufacture of air drying varnish composition (7).	S. Siddiqui.

Serial No.	Indian Patent No.	Whether sealed or pending.	Title.	Applicants.
101.	38063	filed	Improvements in or relating to the conversion of bhilawan shell liquid to a non-vasicating drying product for the manufactures of lacquer varnish, stoving, enamels water proofing or like materials (8).	S. Siddiqui and D. C. Dhar.
102.	38064	„	Improvements in or relating to the composition particularly suited for the manufacture of patent leather.	S. Siddiqui and D. C. Dhar.
103.	to be filed		Improvements in or relating to the production of distillery washes.	Aswatha Narayana Rao and M. Sreenivasa.
104.	to be filed		Improvements in or relating to the activation of bauxite for bleaching purposes.	Sutaone and Saletore.

FOREIGN PATENT APPLICATIONS

U. S. A.

Patent No.	Whether sealed or pending.	Title.	Applicants.
1. U. S. Pat. Appln. No. 577112 dated Feb. 9, 1945.	Filed	Improvements in or relating to the manufacture of containers, receptacles, hollow-ware or the like from resin impregnated laminations.	S. S. Bhatnagar, A. R. Khan and L. C. Verman.
2. U. S. Pat. Appln. No. 677608 dated June 18, 1946.	Filed	Improvements in or relating to the manufacture of containers receptacles, hollow-ware or the like from resin impregnated laminations.	B. N. Sikka, Gurbax Singh and L. C. Verman.

Patent No.	Whether sealed or pending.	Title.	Applicants.
3. U. S. Pat. Appln. No, 745056 dated Apr. 30, 1947.	Filed	Improvements in or relating to magnetic separators. United Kingdom	G. D. Joglekar and L. C. Verma.
4. British Patent No. 592762 Appln. No. 8340/45.	Accepted	Improvements in or relating to the manufacture of containers, receptacles hollow-ware or the like from resin impregnated laminations.	S. S. Bhatnagar, A. R. Khan and L. C. Verma.
5. British Patent Appln. No. 19943/46.	Filed	Improvements in or relating to manufacture of containers receptacles, hollow-ware or the like from resin impregnated laminations.	B. N. Sikka, Gurbax Singh and L. C. Verma.
6. Br. Pat. Appln. No. 25410/46.	Filed	Manufacture of 2 : 4 dichloro-1-amino anthraquinone.	K. Venkataraman and S. G. Bedekar.
7. Br. Pat. Appln. No. 25409/46	Filed	Improvements in or relating to anthraquinone acid dyestuffs.	K. Venkataraman and S. G. Bedekar.
8. Br. Pat. Appln. No. 10893/47.	Filed	Improvements in or relating to magnetic separators.	G. D. Joglekar and L. C. Verma.

APPENDIX V

List of publications by the Council's technical staff including staff working at different research institutions and universities on schemes financed by the Council.

1. Utilisation of Indian vegetable oils as lubricants in internal combustion engines by Aggarwal J. S. and Verman L. C., Bulletins of Indian Industrial Research, No. 18. 3rd Edition 1942.
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3. Vegetable oil mineral oil blends as lubricants by Aggarwal J.S., Bhatnagar S. S. and Verman L. C., Jour. Sci. and Ind. Res. 1942-43, 1,261.
4. Indian vegetable oils as fuels for Diesel engines ; Bulletins of Indian Industrial Research No. 19, 3rd Edition. 1943.
5. Effect of storage on Indian vegetable oils by Aggarwal J. S. Journal of the Indian Chemical Society (Industrial and News Edition), 1942, V. 121.
6. Vegetable oil illuminants by Aggarwal J.S., Joglekar G.D. and Verman L.C., Jour. Sci. and Ind. Res. 2,11,75, 1944.
7. Chemical examination of the seeds of *Mimosa Pudica* Linn. Part I. Analysis of fatty oil by Aggarwal J.S. and Karimullah Jour. Sci. and Ind. Res., 1945 4. 80.
8. Chemical Examination of the fatty oil from the seeds of *Sisymbrium Irio* Linn, by Aggarwal J.S. and Karimullah, Jour. Sci. and Ind. Res. 1946, 5B 57.
9. Particle-size distributions in red lead pigments, by Verman L.C. and Jogarao A. Jour. Sci. and Ind. Res., 1, 82, 1943
10. A viscometric method for studying the kinetics of alcoholysis of esters, by Jogarao A., Jour. Ind. Chem. Soc. 20, 69, 1943.
11. Horn waste as a raw material for the plastics industry, by Bhatnagar S.S., Verman L.C. and Jogarao A., Jour. Sci. and Ind. Res. 2, 166, 1944.

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16. The Hydrogen-Oxygen combination in a Siemen's ozoniser, by Jogarao A., Jour. Ind. Chem. Soc. 22, 57, 1945.
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**Theses submitted utilising the work carried out under the
auspices of the Council of Scientific and Industrial Research.**

M. SC. TECH.

- V. V. Gokhale ... Anthraquinone vat dyestuffs.
S. G. Bedekar ... Some halogenated intermediates and dyes of
the anthraquinone series.

PH.D.

- K. I. Narasimhan ... Coupling and other experiments on natural
phenolic colouring matters.
R. J. Moualim ... The chemistry of some commercial dyes.
S. V. Sunthakar ... Aminoanthraquinones and anthrimides (to be
submitted).

**List of Monographs and Reports published by the
Council of Scientific and Industrial Research**

1. Report of the Dyestuffs Exploratory Committee.
2. Report of the Dyestuffs Exploratory Committee—Appendices
1946.
3. Indian Graphite.
4. Survey of Indian Vetiver (Khus) and its Oil.
5. Report of the Essential Oil Advisory Committee—2nd Edition.
6. Washability of Indian Coal (in press—will be out shortly)
7. Report of Coal Blending and Coking Committee (in press)
8. Silk Production and Weaving in India (in press)

APPENDIX VI

Subsidised Research at Universities and Research Institutes.

No.	Name of Institution	Place	Nature of Problem.	Names of Investigators	Total amount of grant in Rs.
1.	Aligarh University	Aligarh	1. Investigations on alkaloids from Chandni roots. 1940—	Dr. R.H. Siddique (under suspension)	12,390
			2. Chemical investigations on the active principles of Karaaf seeds. 1944-45	Dr. M.O. Farooq (under suspension)	2,980
			3. Isolation of the gelatinizing principle of Bemisal Bel 1947—	Dr. M.A. Aziz	3,040
			4. Scheme on 'Sahar Farsce' 1947—	Dr. M.O. Farooq	3,040
2.	Allahabad University	Allahabad	1. Manufacture of cheap radio sets and volume controls 1941-46	Dr. G.R. Toshniwal	29,503
			2. Manufacture and utilization of rosin 1946—	Dr. N.R. Dhar	6,180
			3. Measurement of absorption co-efficient for sound waves in air and other polyatomic gases 1947—	Dr. R.N. Ghosh	5,378
			4. Chemical effects of X-ray emission and absorption spectra 1947—	Dr. G.B. Deodhar	2,778
			5. Thermionic functions of metals and alloys. 1945—	Sir K.S. Krishnan	3,940
			6. Electrical properties of alloys in the liquid state. 1945—	"	2,800

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
			7. Investigations on electrical properties of some typical order—disorder alloys particularly in the neighbourhood of their Curie temperatures and on the influence of quenching on those properties. 1944—	Sir K. S. Krishnan	8,357
3.	Andhra University.	Waltair	1. Ceramic glazes and colours. 1942—	Dr. G. Gopal Rao	10,015
4.	B. B. C. I. Rly. Workshop.	Ajmer	1. Development of copper-silicon bronzes. 1944-46	Dr. D. R. Malhotra	8,583
5.	Benares Hindu University	Benares	1. Purification of glass sands. 1940-43	Dr. A. Nadel	7,225
			2. Preparation of diethylphthalate. 1942-45	Dr. S. S. Joshi	5,475
			3. Manufacture of potassium perchlorate. 1943-44	Dr. S. S. Joshi	545
			4. Manufacture of carbon disulphide from sulphur and charcoal 1942—	Dr. N. N. Godbole	14,009
			5. Neem oil as a denaturant of alcohol. 1940—	"	8,888
			6. Production and testing of aluminium titanium alloys. 1944-47	Dr. Daya Swarup	7,834
			7. Manufacture of chemical porcelain. 1945—	Prof. V. G. Iyer	8,425
			8. Manufacture of better-class saggars. 1945—	Prof. H.N. Roy	24,710
6.	Bengal Immunity Research Laboratories.	Calcutta	9. Manufacture of seger cones. 1945—	"	9,114
			1. Preparation of 8-amino-quinolines as possible anti-malarials. 1947—	Dr. U. P. Basu	3,000

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
7.	Bengal Tanning Institute.	Calcutta	1. Scheme on leather research 1946—	The Superintendent, Tanning Institute.	27,236
8.	Biochemical Standardisation Laboratory.	Calcutta.	1. Preparation of optically active and racemic forms of compounds (Pharmacological part) 1946—	Dr. B. Mukerjee and Dr. B. B. Roy	5,920
			2. Compilation of a brochure on the indigenous drugs of India. 1947—	Dr. B. Mukerjee and Mr. N. N. Ghosh	2,250
9.	Bombay University (Department of Chemical Technology) Bombay.	Bombay	1. Compilation of a list of organic and inorganic materials for dye-stuff industry. 1941-42	Dr. K. Venkataraman	1,192
			2. Manufacture of synthetic dyes from catechin 1943—	"	8,470
			3. Determination of the constitution of some commercial dyes	"	3,154
			4. Preparation of vat dyes 1941—	"	55,490
			5. Method of extraction of vegetable dyes 1940-43	"	4,100
			6. Manufacture of aniline from chloro-benzene 1941-45.	Dr. G. P. Kane	12,649
			7. Economic utilization of hungay oil & kokum butter. 1942-44	Dr. R.D. Desai and Dr. P.N. Joshi.	2,372
			8. Manufacture of sulphur black from benzene. 1943-46	"	4,071
			9. Sulphonation of vegetable oils. 1940-45	Dr. K.G. Naik	6,192
			10. Economic utilization of turpentine oil for the manufacture of terpenol. 1944—	Dr. R.D. Desai and Dr. P.N. Joshi	1,500
10.	Bose Research Institute.	Calcutta	1. Cutting and testing of quartz crystals. 1942-44	Dr. D.M. Bose	6,200

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
			2. Setting up of a powerful ultrasonic generator. 1940—	Dr. D.M. Bose	23,115
			3. Setting up of a medium-voltage positive-ray discharge tube for the investigation of nuclear disintegration. 1945—	"	9,627
			4. Investigations on trans-uranic elements. 1946—	"	11,600
11.	Botanical Gardens.	Calcutta	1. Rose Cultivation. 1944—	Dr. K.P. Biswas	4,986
12.	Calcutta University (College of Science)	Calcutta	1. Plastics from vegetable oils. 1940-42	Prof. M.N. Goswami	3,651
			2. Splitting of oils. 1940-42	"	3,550
			3. Extraction of ionone from lemon grass. 1940-43	"	9,600
			4. Utilization of commercial xylene for Dettol type of compounds. 1940-42	Mr. P.C. Mitter	1,713
			5. Manufacture of atropine, emetine, etc. 1940-43	"	7,575
			6. Preparation of Enterovioform. 1942-45	"	8,888
			7. Extraction of potash salts from molasses. 1940-43	Mr. P. Ray and Dr. B. Mukerjee	10,171
			8. Preparation of mono and dialkyl anilines. 1941-44	Mr. B.C. Roy	9,164
			9. Preparation of alpha-naphthaline 1942-44	Mr. B. C. Roy	4,400
			10. Radium contents of Indian minerals and mineral springs. 1943-44	Dr. B. D. Nag Chowdhry	1,500

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
11.			Devising a method for testing the quality of optical glass 1940-43	Dr. S. C. Sirkar	2,065
12.			Survey and production of insulating materials and dielectrics for high frequencies. 1940-45	Prof. S. K. Mitra	2,350
13.			Design of electro-acoustical and high frequency apparatus. 1940-45	"	18,957
14.			Ionospheric investigations 1943—	"	20,475
15.			Manufacture of radio valves in India 1942--	"	41,682
16.			Development of a new technique of investigating the ionosphere. 1946—	Prof. S. K. Mitra and Mr. B. M. Banerjee	6,278
17.			Manufacture of vacuum pumps, compressor and refrigeration machinery. 1941—	Prof. M. N. Saha	81,182
18.			Measurement of geological time in India 1944 —	"	14,461
19.			Theoretical investigation on the upper atmosphere. 1943—	"	20,668
20.			Low temperature carbonization of coal 1943—	Dr. B. N. Ghosh	26,365
21.			Extraction of rare earths from monazite sands. 1941—	Dr. P. B. Sirkar	42,987
22.			Chemical composition of the Tipper's collection of rare earth minerals in India. 1947—	"	12,794

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
			23. Fermentative production of butyl alcohol, acetone and of acids generally from molasses. 1943—	Dr. B. C. Guha	53,498
			24. Development of air-driven ultra-centrifuge. 1944—	Prof. K. Roy	29,723
			25. Research on cosmic rays. 1945—	Mr. P. C. Bhattacharya	13,661
			26. Raman spectra and luminiscence of organic compounds at low temperatures. 1947—	Dr. S. C. Sirkar	3,678
			27. Micro-waves emitted from extra-terrestrial sources. 1947—	Dr. H. Rakshit	36,160
			28. Design of moving iron ammeters and voltmeters of commercial grades. 1944—	Prof. P.C. Mahanti	12,140
13.	Cotton Technological Laboratory, Indian Central Cotton Committee.	Bombay	1. Survey of cellulose-bearing materials of India 1941—	Dr. Nazir Ahmad and Dr. D.L. Sen	23,863
14.	Dacca University.	Dacca	1. Desulphurising of coal. 1943—	Dr. J. K. Chowdhry	31,568
			2. Investigations on steroids. 1944-47	Dr. M.C. Nath	11,306
			3. Chromium-plating on glass, wood and other non-metallic materials. 1946—	Dr. B.C. Kar	9,280
15.	Delhi University	Delhi	1. Spectroscopic investigations on fuels and their combustion. 1944—	Dr. W.M. Vaidya	29,277
			2. Preparation and production on a large scale of pure amino-acids from various natural resources and by synthetic methods. 1947—	Mr. Mansaram	3,040

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
16.	Department of Agriculture, Madras.	Madras	1. Khus roots. 1944-46	Mr. C.T. Ityachan	8,583
17.	Department of Agriculture, U.P.	Dehra Dun	1. Cultivation of Oscimum plants. 1947—	Director of Agriculture	5,000
18.	Department of Industries, Travancore.	Trivendrum	1. Agar—agar from sea-weeds. 1942-43	Dr. K. Moudgil	500
19.	Director of Industries, C.P.	Nagpur.	1. Cultivation of patchouli in the Central Provinces. 1943—	Director of Industries, C. P.	2,000
20.	Drug Research Laboratories	Jammu	1. Survey, cultivation and improvement of medicinal plants. 1947—	Sir R. N. Chopra	4,300
21.	Fuel Research Institute	Dhanbad	1. Physical and chemical survey of Indian coals.	Dr. Lahiri.	9,500
22.	Government of Bombay	Bombay	1. Procelain containers for hydrogen peroxide 1944—	Mr. C.P. Shah	2,500
23.	Government of India Mint	Poona Bombay	2. Cultivation of palma rosa 1944— 1. Electrolytic oxidation of potassium manganate to potassium permanganate 1947—	Mr. C. C. Mitter	2,000 3,400
24.	Government Silk Institute.	Bhagalpur	1. Standardisation of dye extracts from the barks of Butea-Frondosa.	Mr. M. N. De	6,421
25.	Indian Association for the Cultivation of Science.	Calcutta	1. X-ray studies of metals and alloys 1946— 2. Study of formation of vortices both theoretical and experimental under conditions obtaining in solar atmosphere. 1947— 3. X-ray investigations of coal 1947—	Mr. K. Banerjee Dr. S. K. Banerjee Mr. K. Banerjee	11,146 8,900 9,600

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
26.	Indian Forest Research Institute.	Dehra Dun	1. Survey of aromatic chemicals of India 1944-45	Dr. S. Krishna	2,000
			2. Survey of aromatic plants of India 1946—	"	5,000
27.	Indian Institute of Science.	Bangalore	1. Manufacture of formaldehyde. 1940-44	Sir J.C. Ghosh	12,318
			2. Manufacture of super phosphates. 1941-45	"	40,953
			3. Manufacture of titanium dioxide. 1942-45	"	13,314
			4. Manufacture of potassium chlorate. 1941-43	"	7,653
			5. Manufacture of phosphorus. 1941-44.	"	17,734
			6. Manufacture of graphite electrodes. 1940-43	Prof. K. Aston	25,244
			7. Manufacture of condensers and resistances. 1940-43	"	12,785
			8. Manufacture of organo-arsenical compounds. 1940-45	Prof. P.C. Guha	10,433
			9. Manufacture of sodium cyanide. 1941-43	Sir J.C. Ghosh	7,250
			10. Manufacture of carborandum and its finished products. 1940-43	Prof. K. Aston	3,785
			11. Manufacture of synthetic adrenaline. 1942-45.	Dr. P. C. Guha	7,678
			12. Pilot plant experiments on aniline, nitrobenzene, etc. 1942-45	"	52,417
			13. Electric furnace treatment of coal rich in sulphur. 1946—	Sir J. C. Ghosh	15,027

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
14.			Manufacture of hydrogen peroxide. 1942—	Sir J. C. Ghosh	49,760
15.			Manufacture of polythenes by the hydrogenation of rubber latex. 1943—	"	21,185
16.			Production of synthetic methanol. 1945—	"	5,263
17.			Production of metallic sodium and magnesium. 1944—	"	77,093
18.			Beneficiation of gypsum and phosphates from the Trichinopoly area. 1941—	"	24,647
19.			Manufacture of beryllium alloys 1944—	"	19,815
20.			Extraction of sulphur compounds from coal. 1942—	"	31,263
21.			Manufacture of butadiene 1943—	"	32,701
22.			Preparation of formaldehyde from power alcohol.	Dr. S. K. K. Jatkar	7,714
23.			Studies in dielectric constants 1946—	"	8,878
24.			Preparation of pre-digested and concentrated food products from edible seed-cakes 1946—	Prof. V. Subrahmanyam.	9,904
25.			Vegetable milks from oil-seeds and related materials. 1946—	"	16,613
26.			Chemistry of penicillin and other anti-biotics. 1944—	"	55,831

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
27.			Treatment and utilization of industrial wastes with special reference to the textile mill wastes of Ahmedabad. 1942—	Prof. V. Subrahmanyam	16,592
28.			Utilization of essential oils as disinfectants. 1945—	"	18,418
29.			Manufacture of good quality vegetable rennet 1942—	"	19,107
30.			Cytogenetics of yeast and fungi with a view to evolve new and potent species. 1946—	Mr. M. Sreenivasaya	16,645
31.			National collection of type cultures 1941—	"	55,851
32.			Production of industrial enzymes. 1943—	"	17,198
33.			Study of conditions favouring the increase of alcohol concentration in distillery washes 1944—	"	13,341
34.			Study of industrial wastes as supplemental sources of nitrogen and vitamins for the fermentation industries 1947—	"	4,500
35.			Aromatic chemicals 1945	Dr. P. C. Guha	14,907
36.			Manufacture of coumarin 1947—	"	1,500
37.			Production of phenol by the benzene sulphonic acid process. 1946—	"	7,077
38.			Preparation of novocaine. 1944—	"	15,536
39.			Fatigue in metals and alloys. 1946—	Prof. Frank Adcock	19,600

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
			40. Development of high-purity manganese and the study of its effects as an alloying element with other non-ferrous metals	Prof. Frank Adcock	
			41. Preparation of musk xylol, musk ambrette and musk ketone. 1947—	Dr. P.C. Guha	4,000
			42. Ultra-sonic velocity in gases and vapours. 1947—	Dr. S.S. Jatkar	3,300
			43. Preparation of new anti malarials.	Dr. P.C. Guha	19,320
28.	Indian Museum	Calcutta	1. Jasmines of India. 1945—	Dr. S.N. Bal	7,410
			2. Crude resin from <i>Pinus Excelsa</i> .	Mr. J.N. Rakshit	—
29.	Indian School of Mines.	Dhanbad	1. Washability of Indian coals 1943—	Dr. C. Forrester	1,05,245
30.	K. G. Medical College.	Lucknow	1. Essential oils from bitter oranges. 1944—	Dr. B.K. Malaviya	2,853
31.	Laxmi Narayan Institute of Technology	Nagpur	1. Utilization of bauxite deposits of C.P. 1945—	Dr. S.A. Salatore	9,678
			2. Investigation on sweet oranges and lemon oils. 1945-46	"	2,500
32.	Madras University (Biochemical Laboratories)	Madras	1. Manufacture of sorbose. 1944—	Dr. M. Demodaran	16,892
			2. Carbohydrate Metabolism in organisms with special reference to oxalic acid and citric acid formations. 1945—	"	15,373
			3. Study of proteins and proteases. 1945—	"	21,093
33.	Madras University (Department of Leather Technology)	Madras	1. Leather Research. 1946—	—	60,000

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
34.	Meteorological Department, Government of India.	Poona	1. Radiation equilibrium in the atmosphere 1946 -	Dr. K. R. Ramanathan	9,180
		Delhi	2. Infra red radiation from the atmosphere and solar radiation. 1946 -	Dr. L. A. Ramdas	2,748
35.	Mysore Iron Works.	Bhadravati, Mysore	1. Manufacture of resistance alloys 1944 -		20,170
36.	Osmania University, Hyderabad.	Hyderabad	1. Splitting of oils 1940-45	Dr. M. Qureshi	19,562
			2. Briquetting of coals 1944-46	"	4,810
37.	Palaeobotanical Laboratory	Lucknow	1. Investigations of micro-palaeobotanical problems. 1946 -	Prof. B. Sahni	8,680
38.	Patna University	Patna	1. Photosensitising dyestuffs 1940-44	Prof. M. N. Doja	5,700
			2. Utilization of waste mica of Bihar. 1942-46	Prof. R. C. Ray	25,000
39.	Presidency College.	Calcutta	1. Study of polar crystals dissolved in glass systems. 1944 -	Dr. S. K. Majumdar	9,137
			2. Production of mesons with the help of Wilson cloud chamber 1946 -	Prof. R. L. Sen Gupta	4,360
40.	Presidency College.	Madras	1. Manufacture of glandular products and utilization of waste products from sharks 1942 -	Dr. B. B. Dey	31,331
			2. Manufacture of photographic developers 1945 -	"	3,115
			3. Manufacture of direct cotton colours 1943 -	"	54,145
41.	Provincial Broadcasting Department.	Madras	1. Reconditioning of lead acid batteries 1945	Mr. V. V. L. Rao	15,959
			2. Salvaging of electrolytic condensers 1945 -	"	16,564

No.	Name of Institution	Place	Nature of Problem.	Names of Investigators	Total amount of grant in Rs.
42.	Punjab University	Lahore	1. Manufacture of high grade refractory clays. 1940-46	Prof. M.L. Joshi	32,270
			2. Manufacture of graphite crucibles 1942-46	"	23,258
			3. Manufacture of optical glass. 1940-45	"	32,420
			4. Manufacture of X-ray tubes and kenotrons 1942-46	Dr. P.K. Kichlu	23,345
			5. Manufacture of diamond tools. 1945—	"	13,296
			6. Manufacture of flash lamps 1945—	"	4,140
			7. Photochemistry of ozone 1946—	"	5,561
			8. Preparation of optically active and racemic forms of compounds suitable as medicinal substances (chemical and physical parts). 1946—	Dr. B.K. Singh	5,620
			9. Co-relation of cosmic ray intensity with atmospheric variables 1946—	Dr. P.S. Gill	5,000
43.	"Radon House" Kalighat	Calcutta	1. Manufacture of X-ray transformers 1941-43	Mr. B. B. Bhowmik	10,734
			2. Manufacture of permanent magnets suitable for electrical instruments. 1945—	"	5,620
44.	Ram, S. (Miss)	New Delhi	1. Manufacture of correcting fluid. 1943—	Miss S Ram	—
			2. Manufacture of duplicating ink. 1943—	"	50

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
45.	Royal Institute of Science.	Bombay	1. Manufacture of photographic materials in India 1941-46	Prof. G.R. Paranjpe	71,060
			2. Manufacture of high-purity salt. 1946—	Dr. Mata Prasad	3,189
			3. Manufacture of gelatin. 1943—	"	20,018
			4. Spectroscopy of fuels and their combustion. 1946—	Dr. N.R. Tawde	18,656
46.	"Salkia", Howrah.	Calcutta	1. Manufacture of graphite crucibles. 1941-46	Mr. S.L. Mukerjee	9,720
47.	St. Xavier's College.	Bombay	1. Establishment of anti-biotic research centre 1947—	Lt. Col. S. S. Bhatnagar	15,540
48.	Tata Institute of Fundamental Research	Bombay	1. Work on astro physics, experimental physics and cosmic radiation. 1946—	Prof. H. J. Bhabha	75,000
			2. High altitude measurement of the penetrating component of cosmic radiation and ground experiments on mesons 1946—	"	20,000
			3. Establishment of a betatron high energy accelerator. 1946—	"	75,000
49.	Tata Iron and Steel Co., Ltd.	Jamshedpur	1. Grain-size control of ferrous and non-ferrous materials. 1946—	Controller of Inspection (Metallurgical) Tisco	29,316
			2. Manufacture of permanent magnets 1942-46	"	48,413
			3. Coke-blending and coking research 1941—	"	1,31,090
			4. Classification and cataloguing of technical literature relating to metals. 1946—	"	4,500

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
50.	Technological Laboratory	Baroda	1. Preparation of alkali and water soluble ethyl cellulose. 1944—	Dr. C. S. Patel	2,457
51.	U. P. Glass Works	Bahjoi	1. Manufacture of optical glass 1940-43	Mr. I. D. Varshney	8,525
52.	Departmental Schemes, Council of Scientific and Industrial Research Laboratories.	Delhi	1. Manufacture of synthetic wool 1940-46	Dr. S. S. Bhatnagar	51,365
			2. Manufacture of ammonium nitrate 1942-43	Dr. S. S. Bhatnagar and Mr. Parkash Narain	1,300
			3. Titanium dioxide from bauxite sludge 1942-45	Dr. S. Parthasarathy	8,050
			4. Manufacture of ammonium phosphate from calcium phosphate 1940-43	Dr. S. S. Bhatnagar	8,613
			5. Serpentina alkaloids, kurchi alkaloids, industrial uses of bhilawan resins, substitutes of agar-agar and mannite 1940—	Dr. S. Siddiqui	74,618
			6. Pyrethrum and pyrethrum substitutes	"	15,424
			7. Anti-malarial Drugs 1944—	"	26,779
			8. Semi-synthetic tanning material 1944—	"	29,890
			9. Neem oil 1942—	"	42,114
			10. Manufacture of ebonite substitutes and allied products. 1943—	"	20,800
			11. Industrial utilization of resins from latices of <i>euphorbioccea</i> 1944—	Dr. S. S. Bhatnagar and Dr. Karimullah	18,747
			12. Extraction of rubber from <i>cryptostegia</i> 1944-46	"	8,120

No.	Name of Institution	Place	Nature of Problem	Names of Investigators	Total amount of grant in Rs.
13.			Preparation of vitamin B ₁ , beemax and marmite. 1944—	Dr. Bashir Ahmad and Mr. P. N. Vohra	18,914
14.			Powder metallurgy 1946—	Dr. K. S. Krishnan	5,703
15.			Carbon electrodes for arc purposes 1940—	"	59,912
16.			Plastics in general 1940—	"	59,803
17.			Polyhydric alcohols from sugars 1944—	Dr. Karimullah	18,747
18.			Investigations of kakra singi, brahmi and brahmi manduki. 1946—	"	10,456
19.			Manufacture of magnesium from magnesite 1942-45 (dropped)	Dr. S. Parthasarathy	7,381
20.			Portable producer gas plant 1942—	Dr. K.S. Krishnan	79,721
21.			Technical applications of ultrasonics	Dr. S. Parthasarathy	33,546
22.			Testing of samples of earth, alloys, broken machinery brought from Hiroshima 1946—	"	150
23.			Manufacture of resistance alloys 1942-44	"	8,560
24.			Extraction of sulphur compounds from coal 1940-46	"	13,716