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# Annual Report

## COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

## 1966-67

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# Annual Report
# 1966-67



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COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
RAFI MARG, NEW DELHI, INDIA

## SOME FACTS AND FIGURES

| | 1965–66 | 1966–67 |
|---|---|---|
| National Laboratories/Institutes | 31 | 30 |
| Museums | 3 | 3 |
| Organizations/Directorates | 6 | 6 |
| Research Committees | 10 | 12 |
| Research Centres | 5 | 2 |
| Research Schemes | 743 | 708 |
| Emeritus Scientists | 5 | 15 |
| Retired Scientists Receiving Grants-in-Aid | 51 | 51 |
| Fellowships | 2474 | 2504 |
| *Ad hoc* | 1476 | 1535 |
| Under Research Schemes | 998 | 969 |
| Research Associations | 10 | 11 |
| Staff | | |
| Scientific | 3406 | 3592 |
| Technical | 4569 | 4630 |
| Administrative | 2463 | 2303 |
| Class IV | 4515 | 4597 |
| Total | 14,953 | 15,122 |
| Research Papers Published* | 864 | 788 |
| Patents Filed | 101 | 110 |
| Monographs, Reports and other Publications | 223 | 192 |
| Periodicals | 42 | 42 |
| Processes Utilized by Industry for Production | 15 | 20 |
| Processes Leased to Industry | 46 | 108 |

Revised Budget for 1966-67 (in lakhs)

| | |
|---|---|
| Capital | Rs 598.118 |
| Recurring | Rs 1071.080 |
| Loan | Rs 10.000 |

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## ABBREVIATIONS

**National Laboratories**

| | |
|---|---|
| CBRI | Central Building Research Institute, Roorkee |
| CDRI | Central Drug Research Institute, Lucknow |
| CECRI | Central Electrochemical Research Institute, Karaikudi |
| CEERI | Central Electronics Engineering Research Institute, Pilani |
| CFRI | Central Fuel Research Institute, Jealgora |
| CFTRI | Central Food Technological Research Institute, Mysore |
| CGCRI | Central Glass & Ceramic Research Institute, Calcutta |
| CIMPO | Central Indian Medicinal Plants Organization, Lucknow |
| CLRI | Central Leather Research Institute, Madras |
| CMERI | Central Mechanical Engineering Research Institute, Durgapur |
| CMRS | Central Mining Research Station, Dhanbad |
| CPHERI | Central Public Health Engineering Research Institute, Nagpur |
| CRRI | Central Road Research Institute, New Delhi |
| CSIO | Central Scientific Instruments Organization, Chandigarh |
| CSMCRI | Central Salt & Marine Chemicals Research Institute, Bhavnagar |
| IIEM | Indian Institute for Experimental Medicine, Calcutta |
| IIP | Indian Institute of Petroleum, Dehra Dun |
| ITRC | Industrial Toxicology Research Centre, Lucknow |
| NAL | National Aeronautical Laboratory, Bangalore |
| NBG | National Botanic Gardens, Lucknow |
| NCL | National Chemical Laboratory, Poona |
| NGRI | National Geophysical Research Institute, Hyderabad |
| NIO | National Institute of Oceanography, New Delhi |
| NML | National Metallurgical Laboratory, Jamshedpur |
| NPL | National Physical Laboratory, New Delhi |
| RRL Bhu. | Regional Research Laboratory, Bhubaneshwar |
| RRL Hyd. | Regional Research Laboratory, Hyderabad |
| RRL Jammu | Regional Research Laboratory, Jammu |
| RRL Jorhat | Regional Research Laboratory, Jorhat |

**Museums**

| | |
|---|---|
| BITM | Birla Industrial & Technological Museum, Calcutta |
| MSTM | Mafatlal Scientific & Technological Museum, Bombay |
| VITM | Visvesvaraya Industrial & Technological Museum, Bangalore |

**Directorates/Organizations**

| | |
|---|---|
| CDEO | Central Design & Engineering Organization, New Delhi |
| DRCIL | Directorate of Research Coordination & Industrial Liaison, New Delhi |
| DSTP | Directorate of Scientific & Technical Personnel, New Delhi |
| Insdoc | Indian National Scientific Documentation Centre, New Delhi |
| PID | Publications & Information Directorate, New Delhi |
| RSPO | Research Survey & Planning Organization, New Delhi |

**Units**

| | |
|---|---|
| ILU | Indian Languages Unit |
| SRU | Science Reporter Unit |
| PPRU | Publicity & Public Relations Unit |

**Cooperative Research Associations**

| | |
|---|---|
| ATIRA | Ahmedabad Textile Industry's Research Association, Ahmedabad |
| BTRA | Bombay Textile Research Association, Bombay |
| CRII | Cement Research Institute of India, Bombay |
| IJIRA | Indian Jute Industry's Research Association, Calcutta |
| IPIRA | Indian Plywood Industries Research Association, Bangalore |
| IPRA | Indian Paint Research Association, Calcutta |
| IRMRA | Indian Rubber Manufacturers' Research Association, Bombay |
| SASMIRA | Silk & Art Silk Mills' Research Association, Bombay |
| SITRA | South Indian Textile Research Association, Coimbatore |
| TRA | Tea Research Association, Calcutta |
| WRA | Wool Research Association, Bombay |

**Research Centres**

| | |
|---|---|
| RCPRC | Rain & Cloud Physics Research Centre, New Delhi |
| SRTEE | School of Research & Training in Earthquake Engineering, Roorkee University |

**Research Committees**

| | |
|---|---|
| CEHRC | Civil Engineering & Hydraulics Research Committee |
| CRC | Chemical Research Committee |
| GMRC | Geological & Mineralogical Research Committee |
| MRC | Metals Research Committee |

## 1.0 NOTABLE EVENTS

1.1 Shri Fakhruddin Ali Ahmed took over as Vice-President, CSIR from Shri M.C. Chagla with effect from Nov. 14, 1966.

1.2 Dr Triguna Sen assumed charge as Vice-President, CSIR with effect from March 16, 1967.

1.3 Dr Atma Ram, Director, CGCRI, took charge of the office of Director-General from Dr S. Husain Zaheer, who proceeded on leave preparatory to retirement, with effect from Aug. 22, 1966.

1.4 The Council entered into scientific collaboration agreements with the Governments of Yugoslavia, Poland, Czechoslovakia, and the USA.

1.5 Greater emphasis has been laid on reorienting the research activities of the Council towards industrial development.

1.6 The National Metallurgical Laboratory, Jamshedpur cooperated with the Indian Institute of Foundrymen to organize the 33rd International Foundry Congress at New Delhi during Dec. 4-9, 1966.

1.7 The Geophysics Research Board, NGRI, Indian Geophysical Union, Geological Society of India and Geological Survey of India organized a symposium on Upper Mantle Project at NGRI during Jan. 4-8, 1967 to take stock of the work done in India so far and to discuss the possibilities of organizing research projects for the remaining period of the project.

1.8 Production units for the Indian Multipurpose Food developed by CFTRI were set up by the Government of West Bengal at Calcutta (2 tons/day), *J.B. Oil Industries*, Sitapur, U.P. (2 tons/day) and *Agarwal Mills*, Kotadwara, U.P. (1 ton/day). A plant designed and fabricated by CFTRI for parboiling of rice on the basis of research findings of the Institute has been set up as an adjunct to the West German modern rice mill set up at Thruvarur in Madras State.

1.9 The total amount accruing from premia, royalty, consultation, testing, analysis and other services during 1966 is estimated at Rs 1,486,022 as detailed: Premia Rs 22,000; Royalty Rs 5,55,548; Project reports, Technical aid etc. Rs 1,14,190; Consultation fee Rs 1,24,278 and Testing, analysis and other services Rs 6,70,006.

## 2.0 SOCIETY, GOVERNING BODY AND BOARD

2.1 The Annual General Meeting of the Society was held on April 16, 1966 in New Delhi when the Annual Report of the Council for the year 1965-66 and the audited statement of accounts for the year 1964-65 were approved and adopted.

2.2 The Board of Scientific & Industrial Research and the Governing Body met in New Delhi on April 15 and 16, 1966 respectively.

2.3 The Governing Body approved the recommendations of the Board in respect of the following:

2.3.1 Reconstitution of the Geophysics Research Board for three years with effect from April 1, 1966

2.3.3 Strengthening of non-ferrous metallurgy research in NML.

2.3.4 Expansion of the fine chemicals project at NCL into a national project by collaboration with other research institutes and industry so that it will not only meet the requirement of fine chemicals of research institutions and university departments in the country but also undertake bulk production of the urgently needed fine chemicals for defence and industry.

2.3.5 Setting up of (i) a unit for manufacture of rare biochemicals at the Vallabhbhai Patel Chest Institute, Delhi under the administrative control of the University of Delhi; (ii) a fire research division at CBRI, whose main function would be to undertake work on the fire resistance of building components and buildings, design and development of fire-fighting in coordination with the fire Service Research and Development Establishment of the Ministry of Defence; and (iii) pilot plants for production of silicon carbide at RRL, Hyd. and of cellulosic pulp at RRL, Jorhat.

2.3.6 Holding of the following three seminars : (i) Hydrogen production and its utilization in petroleum and petrochemical industries at IIP; (ii) Mathematical sciences at Bangalore; (iii) Coastal and nearshore oceanography at Bombay; and (iv) a symposium on International Quiet Sun Year at NPL.

2.4 The Board of Scientific and Industrial Research met in New Delhi on Nov. 18, 1966. The Governing Body met on Nov. 19, 1966 with Shrimati Indira Gandhi, Prime Minister of India, and President of CSIR in the chair.

2.5 The President expressed her appreciation of the work done in the cause of science by Shri M. C. Chagla as Vice-President of CSIR and by Dr S. Husain Zaheer during his tenure as the Director-General. The President extended a warm welcome to Dr Atma Ram, the new Director-General.

2.6 The President laid stress on the country's achieving self-reliance in the context of the difficult economic and food situation, and exhorted the scientists and engineers to play an important role in this direction. The President referred to certain visible gaps in research and hoped that some guidance might be forthcoming from the Indian Science Congress. The need for securing active cooperation between science and industry and for scientists to be associated with the formulation of industrial progress even from the initial stages was stressed.

2.7 The Governing Body held discussion on the ways and means by which the Council could participate more effectively in industrial development.

2.8 There was consensus on the question of converting some of the national laboratories which are oriented to specific industries into research associations in consultation with the industries concerned.

2.8.1 The Governing Body unanimously decided that the Fourth Five-Year Plan proposals of CSIR should be scrutinized carefully *de novo* and that a small committee may be appointed by the President to help the Director-General in this task. A committee has been constituted with the Director-General as Chairman, Shri Arvind N. Mafatlal, Dr S. Bhagavantam, Dr D.S. Kothari, Dr T.R. Seshadri, Dr T.S. Subramaniam, proposals of the Council in order that items which might not have immediate relevance to the country's needs may be deleted and review with this end in view any anticipatory or advance action which might have been taken.

2.8.2 The Governing Body approved the location of NIO in Goa.

2.8.3 It was agreed to set up a common Executive Council for the three museums, namely BITM, VITM and MSTM.

2.8.4 It was decided to celebrate the Silver Jubilee of the Council during 1967. Two committees, one for organizing the celebration and the other for preparation of a comprehensive review of work done by CSIR so far and to formulate guidelines for its functioning in future, were constituted. The organizing committee consists of Vice-President as the chairman and Dr A. Ramaswami Mudaliar, Shri Kasturbhai Lalbhai, Prof. M.S. Thacker, Dr S. Husain Zaheer, Dr Atma Ram (DGSIR), Secretary, CSIR and Financial Adviser to CSIR as members.

2.8.5 Financial assistance was sanctioned to Cement Research Institute of India and Wool Research Association, Bombay.

2.8.6 The Governing Body approved a scheme relating to terms and conditions of appointment of Emeritus Scientists in the Council.

2.8.7 Holding of the following symposia/seminar during 1967 was approved : (i) Symposium on 'Upper Mantle Project' (at NGRI in collaboration with the Geological Survey of India, the Geophysics Research Board, the Indian Geophysical Union and the Geological Society of India); (ii) Symposium-cum-lecture programme on 'Millimetre and Submillimetre Wave Spectroscopy' (at NPL in collaboration with the University of Delhi); (iii) Symposium on 'Site Investigations for Foundations' (at CBRI); (iv) Symposium on 'Scientific Results of the International Indian Ocean Expedition' (in New Delhi under the joint auspices of the Indian National Committee on Oceanic Research and National Institute of Sciences of India); (v) Symposium on 'Quality Control in the Construction of Roads and Runways' (at CRRI in combination with a Technical Conference of the Chief Engineers of the Centre and the States dealing with highways, Representatives of Engineer-in-Chief of Border Roads Organization and Chief Engineers of Municipal Corporations); and (vi) the Seventh Seminar on 'Electrochemistry' (at CECRI).

2.9 The membership of the Society, Governing Body and Board is given in App. 1.

## 3.0 NATIONAL LABORATORIES AND DIRECTORATES/ ORGANIZATIONS

### 3.1 National Laboratories

3.1.1 Thirty-three national laboratories including NBG, CIMPO, CSIO, three industrial and technological museums (BITM, VITM & MSTM), and two research centres (SERC & ITRC) functioned during the year; of these, three institutions, RRL, Bhu., ITRC and MSTM, were in the planning stage.

laboratories are given in App. 3. The membership of Executive Councils of the national laboratories is given in App. 4.

3.1.3 The sixteenth Conference of the directors and heads of national laboratories was held at NAL on July 4 & 5, 1966.

3.1.4 Important recommendations in regard to national research projects, industrial liaison, research utilization and inter-laboratory collaboration were made at the conference. Some of the important recommendations were the following:

3.1.4.1 Strengthening of existing research advisory committees in national laboratories.

3.1.4.2 Seeking collaboration of other national laboratories in projects: towards this end it was suggested that every laboratory should circulate its project proposals to other laboratories at the formative stage and seek comments regarding desirable collaboration so that identification of various subjects in which different laboratories had common interest could be brought about automatically.

3.1.5 A new division of mineral technology was created at CFRI.

3.1.5.1 A biopolymer laboratory was added to CLRI in Nov. 1966.

3.1.5.2 A new field centre for fire research, the CBRI Field Cell was opened at Vijayawada, Andhra Pradesh.

3.1.5.3 Two new research laboratories, one for Plant Breeding and Virology, and a division of Floristic Botany and Nomenclature were set up at NBG.

3.1.5.4 Two new sections for (i) Pharmacology, Animal Experimentation and Experimental Surgery and (ii) Pathology were opened at IIEM.

3.1.5.5 A Creative Centre for school students was started at BITM in Nov. 1966.

3.1.5.6 A Rural Sanitation Workshop for giving training to the sanitary inspectors of the region was started at CPHERI.

3.1.5.7 Three Extension Centres called MERDO (Mechanical Engineering Research and Development Organization), of CMERI started functioning one each in Ludhiana, Poona and Madras.

3.1.5.8 In order to give incentive to industry for the development of certain specialized instruments, CSIO has set up Development Centres with well-established instruments manufacturing concerns.

3.1.5.9 A Geoelectric Observatory of NGRI for studies of rapid variation of earth's electromagnetic field was established at Choutuppal (60 km. east of Hyderabad).

3.1.5.10 A Regional Research Centre of SERC was established at Madras.

3.1.6 Foundation-stone of a pilot plant building at RRL Jammu was laid by Shri M.C. Chagla on May 28, 1966.

3.1.6.1 Foundation-stone of the main laboratory building of RRL

3.1.6.2 Foundation-stone for the Systems Engineering Building of NAL was laid by Shri M.C. Chagla at Lodihalli on July 5, 1966.

3.1.6.3 Foundation-stone of NGRI was laid by Shrimati Indira Gandhi, on Jan. 3, 1967.

3.1.7 A new building, housing the pilot plants of CLRI was declared open on Aug. 24, 1966.

3.1.8 NBG acquired the membership of the following societies during the year: National Chrysanthemum Society of America; Society for Economic Botany, New York; Delhi Agri-Horticultural Society, Delhi; and Rose Society of India, New Delhi.

3.1.9 The first convocation of the 3-year training course in Instrument Technology at the Indo-Swiss Training Centre of CSIO was held on Aug. 19, 1966. An exhibition of instruments and components developed at the Organization was organized on the occasion.

3.1.10 Pilot plants in respect of the following projects were commissioned: (i) production of coal fertilizer at CFRI (Feb. 1, 1966); (ii) production of prestressed concrete pavements and pulverization of black cotton soil at CRRI; (iii) production of potassium chloride and epsom salt at Kandla by CSMCRI (March 1966); (iv) a briquetting maturing unit and two pilot plants for the production of benzyl acetate and benzyl alcohol and extraction of cottonseed oil respectively at RRL, Hyd.; (v) experimental production of dry yeast from petroleum hydrocarbons, iron from waste iron ore fines, and deinking of old newspapers at RRL, Jorhat; (vi) Oxidation ditch at CPHERI, sludge digester at Hyderabad and defluoridation at Gangapur (Rajasthan).

3.1.11 During the year as many as 14 projects were being investigated under inter-laboratory collaboration (App. 5).

3.1.12 Twenty projects were under investigation in collaboration with research institutions, industry and organizations outside CSIR (App. 6).

3.1.13 Nine laboratories, NCL, CECRI, NBG, CSMCRI, RRL Jammu, IIEM, CIMPO, CSIO and NAL, collaborated with universities in research projects. Ten laboratories, NCL, CFTRI, CGCRI, CDRI, CRRI, RRL Hyd., IIEM, CSIO and NGRI, collaborated with universities in lecture programmes (App. 7).

3.1.14 The research activities of the national laboratories have resulted in the publication of 788 research papers (App. 26) and taking of 110 patents (App. 10). As many as 108 processes worked out have been released for industry for commercial development (App. 11). The total number of processes which are being exploited are 20 (App. 12). The laboratories brought out as many as 146 publications besides, 28 periodicals (App. 13).

3.1.15 Details of technical aid rendered by national laboratories are given in App. 9.

3.1.16 The national laboratories have also been offering technical consultancy service and advice to industries and other user organizations to the extent possible. The service can be broadly divided into the following four categories; (i) General technical consultancy, (ii) specific project

3.1.17 Thirteen laboratories participated in several exhibitions. Appendix 14 gives the list of laboratories and the exhibitions in which they participated.

3.1.18 As in the previous years, several eminent scientists from foreign countries visited the Council's laboratories; the list of visitors is given in App. 15.

3.1.19 Details of recognition of national laboratories by universities for post-graduate work; symposia, seminars, etc. organized by the laboratories; pilot plants installed; and schemes sponsored by outside organizations in the laboratories are given in App. 16, 17, 18 & 19 respectively.

3.1.20 A brief record of significant contributions of the Council's research institutions, including the museums is included discipline and laboratory-wise under 'Brief record of research of national laboratories'.

### 3.2 Directorates/Organizations

3.2.1 Six directorates/organizations—PID, Insdoc, CDEO, DSTP, RSPO and DRCIL—were functioning. Besides, there were three units—ILU, PPRU and SRU.

3.2.2 The work of the directorates/organizations is summarized under 'Progress of work in directorates/organizations'.

## 4.0 SPONSORED RESEARCH

### 4.1 Cooperative Research Associations

4.1.1 Eleven research associations were functioning during the year (App. 2). Of these, IRMRA, IPRA, CRII and WRA were in the development stage. Cooperative research associations for Electronics and Automobile industries were registered during the year.

### 4.2 Research Centres

4.2.1 The following two research centres were functioning during the year: Rain & Cloud Physics Research Centre, NPL, and School of Research and Training in Earthquake Engineering, Roorkee University. A scheme for manufacture of some rare biochemicals at the Vallabhbhai Patel Chest Institute, Delhi was sanctioned.

4.2.2 The research contributions of the centres are given under 'Brief record of sponsored research'.

### 4.3 Research Committees

4.3.1 A Chemical Engineering Research Committee was constituted. The Geophysics Research Board was reconstituted. It was decided to hold conventions of Biological, Chemical, Civil Engineering and Hydraulic and Physical Research Committees to take stock of the progress of research and plan research in uncovered areas. In addition, research schemes

4.3.2 During the year, 566 schemes were recommended for renewal and 144 schemes were sanctioned. The number of schemes renewed and new schemes sanctioned (in bracket) research committee-wise are as follows: Aeronautical, 4; biological, 82(31); chemical, 288(43); chemical engineering, (1); civil engineering and hydraulics, 20(6); electrical and mechanical engineering, 11(6); geological and mineralogical, 36(4); geophysics, 1; metals, 13(3); mining 1(2); pharmaceuticals & drugs, 27(7); physical, 111(38); public health engineering (1); radio, 9(2); rain and cloud physics, 2; CLRI, 2; CSIO, 2; CFRI, 1; CIMPO, 5; and miscellaneous, 1.

4.3.3 A large number of schemes of research (both fundamental and applied) were under investigation under the auspices of the Civil Engineering and Hydraulics Research Committee.

4.3.4 Under the Pharmaceuticals and Drugs Research Committee, 17 research schemes and 7 research units and one Clinical Drug Trial Centre were functioning; 4 more schemes and one Chemical Drug Trial Centre at the Pharmacology Department, King George's Medical College, Lucknow, were approved.

4.3.5 The first Annual Convention of Investigators-in-charge of research schemes and units functioning under the Committee was held on April 6, 1966 at CDRI. Out of 33 research schemes/units, 28 were represented by 32 participants. The investigators and research workers reviewed the progress of work done in their respective schemes.

4.3.6 Under the Chemical Research Committees, 217 schemes were in operation and about 60 schemes were terminated. About 60 papers were published in Indian and foreign journals.

4.3.7 The progress of research in schemes under research committees is given under 'Brief record of sponsored research'.

### 4.4 Research Schemes

4.4.1 Seven hundred and eight research schemes were in progress during the year at 128 centres (including universities) as against 743 during the previous year. The number of research fellows/assistants working in the schemes was 969 as against 998 in the previous year. The institution-wise distribution of research schemes and fellowships is given in App. 25.

### 4.5 Retired Scientists

4.5.1 Fifty-one retired scientists were provided grants for research in their respective fields; six of them were sanctioned grants for the first time during the year. The list of retired scientists appointed during the year is given in App. 20.

### 4.6 Fellowships

4.6.1 The number of *ad hoc* fellowships during the year was 1535. Of these, 118 senior research fellowships (SRF) and 197 junior research fellowships (JRF) were working in the national laboratories and the remaining 306 SRF and 914 JRF were working in universities, affiliated colleges and other research institutions. The distribution of fellowships in national

## 5.0 BUILDINGS

5.0.1 The acquisition of land for the expansion of the laboratories and the progress of building construction are given in App. 21.

## 6.0 SCHOLARSHIPS

6.0.1 German Academic Exchange Service of Federal Republic of Germany offered 16 scholarships to CSIR scientists for advanced study and research in German educational institutions.

## 7.0 DEPUTATIONS

7.0.1 The particulars of deputations of Director-General, Directors and Scientists of the Council who visited foreign countries for participation in conferences or for advanced research and/or training are given in App. 22.

## 8.0 SPECIAL TRAINING COURSES

8.0.1 The Council extended training facilities to students, technical personnel from industry and government organizations and to others who sought practical training by conducting (i) regular courses, short term courses in various disciplines of science; (ii) summer schools on selected subjects with the collaboration of national and international organizations, and (iii) by imparting training in pilot plant operation and apprising trainees with the latest techniques in scientific research.

8.0.2 The details of special training courses are given in App. 23.

## 9.0 INTERNATIONAL COLLABORATION

9.1 An agreement between India and USA providing for an exchange of scientists and engineers was entered into on Feb. 14, 1967. The agencies responsible for carrying out the exchange programme will be CSIR for India and National Science Foundation for USA.

9.2 The agreement for collaboration between CSIR and the Institute Francais du Patrole (IFP), Paris, under Indo-French Technical Cooperation, has been extended for a further period of three years with effect from Jan. 1, 1966. Under the extension of the agreement, IFP will: (i) provide services of a maximum of 13 French experts for a total of 154 man-months, (ii) train in its laboratories 6 trainees for a total of 18 man-years, and (iii) help in securing necessary scientific equipment abroad and will provide such equipment against rupee payment for a maximum of 1,00,000 French francs.

9.3 The agreement between CSIR and the Swiss Foundation for Technical Assistance, Zurich, for the establishment of an Indo-Swiss Training Centre at Chandigarh has been extended up to Aug. 31, 1968 and thereafter there would be automatic extension year by year up to 1970.

9.4 Financial assistance has been provided from P.L. 480 funds for the project 'Wood phenolics with special reference to their use in chemotaxonomy

9.5 The details of other international collaborative work are given in App. 8.

9.6 The details of aid received by laboratories from foreign governments, agencies or international organizations are included in App. 24.

## 10.0 STAFF CHANGES AND HONOURS & AWARDS

### 10.1 Appointments

| | |
|---|---|
| Dr Atma Ram | Director-General, SIR (Aug. 22, 1966) |
| Prof. S.R. Mehra | Director, CRRI—acting Director-General, SIR (May 3 to June 27 & Aug. 28 to Sept. 15, 1966) |
| Dr B.D. Tilak | Director, NCL (June 6, 1966) |
| Prof. R.B. Arora | Director, IIEM (Aug. 4, 1966) |
| Dr T. Banerjee | Scientist-in-Charge, NML (Aug. 23, 1966) |
| Shri K.D. Sharma | Scientist-in-Charge, CGCRI (Aug. 29, 1966) |
| Prof. M.V. Bopardikar | Scientist-in-Charge, CPHERI (Dec. 26, 1966) |

### 10.2 Merit Promotions

Shri S.K. Das Gupta, CFRI, Scientist E—Scientist F (April 19, 1966)
Dr B.N. Singh & Dr A.B. Kar, CDRI, Scientists E—Scientists F (April 19, 1966)
Dr J.S. Agarwal, RRL Hyd., Scientist E—Scientist F (April 19, 1966)
Dr A.B. Chatterjee, NML, Scientist E—Scientist F (June 7, 1966),
Shri A.K. Chakravarti, CFRI, Scientist C—Scientist E (April 18, 1966)
Dr P.V.S. Narayan, NGRI, Scientist C—Scientist E (April 21, 1966)

### 10.3 Emeritus Scientists

10.3.1 Fifteen emeritus scientists were provided grants for continuing their research work after retirement.

### 10.4 Retirements

Dr S. Husain Zaheer, Director-General, SIR (Nov. 6, 1966)
Dr K. Venkataraman, Director, NCL (June 6, 1966)
Shri R.S. Mehta, Director, CPHERI (Dec. 26, 1966)

### 10.5 Honours & Awards

10.5.1 The Shanti Swarup Bhatnagar Memorial Awards for the years 1963 and 1964 were presented by Shrimati Indira Gandhi to the recipients at NPL on July 29, 1966.

10.5.2 Dr Atma Ram, Director-General, Scientific &

## 5.0 BUILDINGS

5.0.1 The acquisition of land for the expansion of the laboratories and the progress of building construction are given in App. 21.

## 6.0 SCHOLARSHIPS

6.0.1 German Academic Exchange Service of Federal Republic of Germany offered 16 scholarships to CSIR scientists for advanced study and research in German educational institutions.

## 7.0 DEPUTATIONS

7.0.1 The particulars of deputations of Director-General, Directors and Scientists of the Council who visited foreign countries for participation in conferences or for advanced research and/or training are given in App. 22.

## 8.0 SPECIAL TRAINING COURSES

8.0.1 The Council extended training facilities to students, technical personnel from industry and government organizations and to others who sought practical training by conducting (i) regular courses, short term courses in various disciplines of science; (ii) summer schools on selected subjects with the collaboration of national and international organizations, and (iii) by imparting training in pilot plant operation and apprising trainees with the latest techniques in scientific research.

8.0.2 The details of special training courses are given in App. 23.

## 9.0 INTERNATIONAL COLLABORATION

9.1 An agreement between India and USA providing for an exchange of scientists and engineers was entered into on Feb. 14, 1967. The agencies responsible for carrying out the exchange programme will be CSIR for India and National Science Foundation for USA.

9.2 The agreement for collaboration between CSIR and the Institute Francais du Patrole (IFP), Paris, under Indo-French Technical Cooperation, has been extended for a further period of three years with effect from Jan. 1, 1966. Under the extension of the agreement, IFP will: (i) provide services of a maximum of 13 French experts for a total of 154 man-months, (ii) train in its laboratories 6 trainees for a total of 18 man-years, and (iii) help in securing necessary scientific equipment abroad and will provide such equipment against rupee payment for a maximum of 1,00,000 French francs.

9.3 The agreement between CSIR and the Swiss Foundation for Technical Assistance, Zurich, for the establishment of an Indo-Swiss Training Centre at Chandigarh has been extended up to Aug. 31, 1968 and thereafter there would be automatic extension year by year up to 1970.

9.4 Financial assistance has been provided from P.L. 480 funds for the project 'Wood phenolics with special reference to their use in chemotaxonomy and their biosynthesis by tissue cultures' at NCL for a period of [illegible]

9.5 The details of other international collaborative work are given in App. 8.

9.6 The details of aid received by laboratories from foreign governments, agencies or international organizations are included in App. 24.

## 10.0 STAFF CHANGES AND HONOURS & AWARDS

### 10.1 Appointments

| | |
|---|---|
| Dr Atma Ram | Director-General, SIR (Aug. 22, 1966) |
| Prof. S.R. Mehra | Director, CRRI—acting Director-General, SIR (May 3 to June 27 & Aug. 28 to Sept. 15, 1966) |
| Dr B.D. Tilak | Director, NCL (June 6, 1966) |
| Prof. R.B. Arora | Director, IIEM (Aug. 4, 1966) |
| Dr T. Banerjee | Scientist-in-Charge, NML (Aug. 23, 1966) |
| Shri K.D. Sharma | Scientist-in-Charge, CGCRI (Aug. 29, 1966) |
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### 10.5 Honours & Awards

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10.5.2 Dr Atma Ram, Director-General, Scientific [illegible]

10.5.3 Dr A. Lahiri, Director, CFRI, nominated member, Coal Advisory Council, Ministry of Mines and Metals; Coal Blending and Coking Research Sub-Committee, Jamshedpur.

10.5.4 Dr B.R. Nijhawan, Director, NML, appointed Inter-Regional Senior Adviser to the United Nations at New York for a period of two years on foreign service; awarded Silver Plaque on the occasion of the 33rd International Foundry Congress for his valuable contributions in research and development work pertaining to foundry technology as well as for the growth of foundry industry in India.

10.5.5 Prof. K.S.G. Doss, Director, CECRI, elected (i) President of the Institution of Chemists (India) for 1966-67; (ii) one of the Vice-Presidents of the Board of CITCE.

10.5.6 Prof. R.B. Arora, Director, IIEM, nominated member of (i) Scientific Advisory Board, (ii) Pharmacology Expert Group, and (iii) Advisory Committee on Indigenous Drugs of the Indian Council of Medical Research.

10.5.7 Shri R.S. Mehta, Director, CPHERI, elected Vice-President for the Third International Conference on Water Pollution Research by the Permanent Steering Committee of the International Association of Water Pollution Research. He presided over the Conference held at Munich (Sept. 5, 1966).

10.5.8 Shri B.S. Kesavan, Director, Insdoc, presented the Scroll of Honour by the Institute of Indian Foundrymen for the valuable service rendered as Chairman, Foundry Books Exhibition, 33rd International Foundry Congress held at New Delhi.

10.5.9 Dr P.S. Gill, Director, CSIO, appointed Honorary Professor of Physics, Panjab University, Chandigarh; also nominated to the following Committees: Member, Board of Governors of the Indian Institute of Technology, Kanpur; Member, Study Group for Instrumentation of the Planning Commission; and Convener, Study Group in Instrument Technology appointed by the Technical Manpower Assessment Committee of the Ministry of Education.

10.5.10 Prof. G.S. Ramaswamy, Director, SERC, elected (i) Chairman, Shell Structures Group of the Institution of Engineers (India); (ii) Chairman, Roorkee Sub-Centre of the Institution of Engineers (India) for one year; appointed Director, National Buildings Construction Corporation.

10.5.11 Dr S.H. Zaidi, Director, ITRC, elected Founder Member of College of Pathologist, London.

10.5.12 Shri S. Bagchi, Scientist, CFRI, elected a corporate member of the Institution of Mining Engineers, London; and title 'Chartered Engineer' conferred on him.

10.5.13 Dr R.L. Thakur, Scientist, CGCRI, appointed Member, Editorial Board of 'International Journal of High Temperatures and Refractories', France.

10.5.14 Dr C.V. Suryanarayana, Scientist, CECRI, awarded Fellowship, of the Royal Institute of Chemistry (FRIC), London.

10.5.16 Dr P.K.K. Nair, Scientist, NBG, acted as Chairman of one of the sessions of the Second International Conference on Palynology held at Utrecht, Netherlands (Aug. 21, Sept. 3, 1966); also elected a member of the International Working Group of Palynologists.

10.5.17 Dr D.J. Mehta, Scientist, CSMCRI, elected a senate member of the Faculty of Science, Saurashtra University.

10.5.18 Dr E.K. Janaki Ammal, Emeritus Scientist, RRL Jammu, appointed Honorary Professor of Botany in Jammu & Kashmir University.

10.5.19 Dr D. Ganguli, RRL Jorhat, elected Fellow of Indian Phytopathological Society (PPSI).

10.5.20 Shri M.S. Kothari, Scientist, RRL Jorhat, elected a corporate member of the American Institute of Chemical Engineers.

10.5.21 Dr T. Banerjee, Scientist-in-charge, NML, awarded Silver Plaque and Scroll of Honour for his contribution made for the 33rd International Foundry Congress.

10.5.22 Prof. S.R. Mehra, Director and Shri T.K. Natarajan, Scientist, CRRI, awarded AIMIL gold medal by the Indian National Society of Soil Mechanics and Foundation Engineering for their paper 'Foundation treatment of ore-handling yard by preloading with vertical sand drains' presented to the sixth International Conference on Soil Mechanics and Foundation Engineering held at Montreal.

10.5.23 Prof. K.S.G. Doss, Dr V.K.N. Rao and Shri A.K. Abdul Waheed, CECRI, awarded collectively the first prize of Rs 5000 by the Inventions Promotion Board for the development of porous carbon electrode for use in air-depolarized cells.

10.5.24 Dr G.S. Sidhu, Director, RRL Hyd., awarded Dr K.G. Naik Gold Medal for 1966 by the M.S. University of Baroda for his contributions to published research in the field of Chemistry which have found, or are most likely to find, applications in developing Indian industries.

10.5.25 Shri R.M. Krishnan, Scientist, NML, awarded Scroll of Honour at the 33rd International Foundry Congress for his valuable contributions as Editor of the Foundry Directory.

10.5.26 Sarvashri S. Parthasarathy, V. Ramachandran and T.S. Rajagopalan, Scientists, Insdoc, awarded Scroll of Honour at the 33rd International Foundry Congress for organizing the Foundry Books Exhibition.

10.5.27 Shri J.E. Mannar, Scientist, NML, awarded Silver Medal and Scroll of Honour for his contributions made as Editor of the Foundry Congress Volume.

10.5.28 Shri V. Muthukrishnan, Scientist, NML, awarded Silver Medal and Scroll of Honour for bringing out the Foundry Directory.

10.5.29 Dr A.B. Kar, Scientist, CDRI, awarded Dr P.N. Raju award for 1966 (ICMR) for his valuable contributions in the field of Family Planning.

10.5.30 Dr K.S. Rajagopalan and Sarvashri N. Subramanyan and M. Sundaram, Scientists, CECRI, awarded a prize of Rs 1000 collectively

10.5.31 Shri Raghubir Singh and Dr K.S. Balain, Scientist, CEERI, given 'Best Paper-ITE Award' for 1965 for their paper 'Growth and photo-etching of oxide layers on silicon'.

10.5.32 Dr G.T. Gadre and Shri N.N. Udwadia, Scientists, CSMCRI, awarded cash prize of Rs 2000 by the Inventions Promotion Board for their invention 'Potassium schoenite fertilizer from mixed salt'.

10.5.33 Dr K. Seshadri, Sarvashri G.D. Bhat and J.R. Sanghavi, Scientists, CSMCRI, awarded cash prize of Rs 2000 by the Inventions Promotion Board for their invention, 'Potassium alum from the mixed salt'.

10.5.34 Sarvashri A.V. Rao, I.C. Mody and H.N. Shah, Scientists, CSMCRI, awarded a cash prize of Rs 2000 by the Inventions Promotion Board for their invention, 'Sodium alginate from Indian seaweeds'.

10.5.35 Sarvashri B.P. Choudhary & V.N. Lele, Scientists, CSMCRI, awarded a prize of Rs 500 by the Inventions Promotion Board for their invention, 'Preparation of potassium schoenite by dissolution technique'.

10.5.36 Dr K.T. Achaya and Shri A.J. Pantulu, Scientists, RRL Hyd., awarded the Jaipuria Gold Medal of the Oil Technologists' Association of India, Kanpur, for 1964 for the best work published in their journal.

10.5.37 Dr B.K. Ray, Scientist, CMERI, awarded the Sir Rajendranath Mukerjee Memorial Gold Medal by the Institution of Engineers (India) for the joint paper 'Influence of fluid properties in heat transfer with reference to heat exchangers'.

10.5.38 Dr P.S. Shetty, Senior Scientific Assistant, NCL, awarded Ratanji Ranchhodiji Desai Gold Medal, 1962-63 (Inorganic Chemistry Branch) by the Syndicate of the Bombay University for his thesis, 'Studies on the formation of metal complexes in sodium triphosphate solutions'.

10.5.39 Shri S.S. Jain, Junior Scientific Assistant, SERC, awarded a prize of Rs 2000 by the Inventions Promotion Board for his invention of the 'Structural Designer'.

10.5.40 Shri P.V.K. Iyer, Junior Stenographer, NML, awarded Silver Medal for his valuable services rendered to the 33rd International Foundry Congress Secretariat.

## 11.0 FINANCE

11.0.1 The revised financial provisions for the Council for 1966-67 in respect of recurring and capital grants are Rs 1071.080 and Rs 598.118 lakhs respectively.

11.0.2 The summary of the expenditure during the year ending March 31, 1966 is given in App. 27. The consolidated statements of (i) receipt and payment, and (ii) income and expenditure account for 1965-66 are given in App. 28 and 29 respectively. Besides, the consolidated statement of liabilities and assets as on March 31, 1966 is given in App. 30. Details of contingent expenditure during 1965-66 are given in App. 31.

## Obituary

Prof. P. Maheshwari, FRS, who was associated with the Council as a member of the Governing Body, Biological Research Committee and

## 12.0 BRIEF RECORD OF RESEARCH OF NATIONAL LABORATORIES

### 12.1 Physics

**12.1.1 NPL** — A project on improving the efficiency of Indian made sirens was taken up. Open air measurements on sound intensity and polar response in different planes were carried out and sound power output estimated from these observations. Air flow measurements were made with the help of an anemometer. Design of a pilot tube for more accurate measurements was completed. Various sources of noise with non-directional output properties were tried to simulate the output from the siren.

12.1.1.1 Electrical and thermal conductivities of dilute magnetic alloys at low temperature have been determined. The thermal conductivity at liquid helium temperature has been measured on a polycrystalline rod of nickel-zinc-ferrite. The data have been analysed and found to yield interesting information.

12.1.1.2 Topology of d-bands in transition metals including s-d interaction has been studied. It has been possible to see quantitatively how sensitive is the d-band level in relation to changes in the crystal potential.

12.1.1.3 The typical spectral distributions for 6500°, 7500°, 10000° K. recommended for daylight standards by CIE were constructed from the average values of the distributions of neighbouring temperatures. They were compared with the typical distributions for England, USA, Canada and South Africa. The chromaticity points on x, y diagram were grouped into various ranges of colour temperature as belonging to typical conditions of the sky.

12.1.1.4 Data on the spectral distribution of daylight at Bombay were collected for a period of three weeks in October-November 1966. Data on other meteorological factors like relative humidities, presence of fog on the atmosphere were obtained from the Meteorological Observatory, Colaba, Bombay with the object of looking for correlations between spectral data and meteorological factors.

12.1.1.5 Quantitative spectroscopic studies in diatomic molecules were carried out. Investigations on the evaluation of molecular parameters like band strengths, oscillator strengths and electronic transition moments were continued. The investigations were made mainly in respect of the atmosphere as molecules particularly $N_2$ and CO but other molecules which are important from spectroscopic point of view in the upper atmosphere like AlO and NS were also studied. Analysis of some of the band systems of $N_2$ and NO were completed.

12.1.1.6 The methodology of optical computation and design on IBM 1620 computer was developed and is being constantly improved upon. With this primary design, targets for various optical systems likely to be required in the near future have been worked out and the systems are being designed and optical design data compiled. The following are a few of the 18 such designs: Microscope eyepiece Huygenian type 5x, 10x, 15x; microscope eyepiece Ramsden Nol 15x; epidiascope epiobjective triplet 400/f/4;

cemented triplet 425/f/3; and projection apparatus objective two doublet 475/f/B.5. Prototypes of 5x, 10x and 15x eyepieces have been received from the industry. These are being critically examined in consultation with the users. Preliminary examination has shown that these are comparable to any foreign eyepieces and critical specifications are being stipulated to produce eyepieces of export (international) quality.

12.1.1.7 To study the structural changes in solids which exist only while it is under pressure, a high pressure X-ray apparatus has been developed. This will enable studies on solids under high pressure by X-ray technique to be undertaken.

12.1.1.8 Studies of rheological properties of shell and core mixes used in projector carbons and of pure tars and pitches used in binders in projector carbons have been carried out.

12.1.1.9 The conditions of measurement in order to get repeatable and reliable results in extrusion have been determined. A new approach has been made to explain irregularities of the extrudate.

12.1.1.10 Study of permeability of air through many industrial powders was made. Some of these powders were analysed for particle size distribution by sedimentation method. A theoretical study of surface area and pore volume distribution of powders was made using published data. An equation was derived for the computation of the distributions.

12.1.1.11 Regular daily measurements of absolute value of the solar radio flux at 2000 Mc/s. were started for the first time in India.

12.1.1.12 Regular patrol of solar flares was kept by various radio techniques and a number of flares were recorded and reported. This information is vital not only for radio service organizations but also to manned space flights.

12.1.1.13 From a statistical analysis it was established that the chance of sudden ionospheric disturbance occurrence due to solar flare was more whenever there was abnormal increase of solar flux in 10.7 cm. above a threshold value of 110 units during IQSY (solar minimum) period.

12.1.1.14 An exhaustive study was made of the aeronomy of the bottom side ionosphere (below 250 km.) using the measurements of XUV radiations and ion composition by rockets and satellites.

12.1.1.15 From an analysis of X-ray events measured by Ariel and Vela satellites and the accompanying SCNAs a value of $3 \times 10^{-8}$ cm.$^3$ sec.$^{-1}$ was obtained for $\alpha_D$ ($NO^+$). This result is of importance in the aeronomy of the lower ionosphere.

12.1.1.16 Theoretical ion composition model valid for daytime during solar minimum condition was developed consistent with space measurements.

12.1.1.17 A method for the determination of mean field height used in the estimation of total electron content from the Faraday facing of satellite signals was developed. The variation of total electron content over Delhi was thoroughly studied for the sunspot minimum period (1964-65 covering IQSY).

of 2 gauss. The line is symmetrical about the base line which gives the same size of the particle as determined by other methods.

12.1.1.19 The analysis of electrical results of vanadium film shows that the films are not continuous but are in the form of granules. The possible mechanism of conduction between the granules has been studied and a model to interpret the experimental results given.

12.1.1.20 Electrical conductivity and optical absorption of LiF crystals containing Ti impurity has been studied. The presence of Ti impurity has been shown by the appearance of a new optical absorption band peaking at 207 mμ. On X-irradiation, two new bands, in addition to the F band, have been observed. These bands are unstable with respect to heat as well light absorbed by these bands.

12.1.1.21 The absorption spectra of a series of indicators, phthaleins and sulphophthaleins, viz. phenolphthalein, phenolthymolphthalein, thymolphthalein, and cresol red, thymol blue have been taken at different *p*H. Results of specific colour discrimination of some of these have been calculated.

## 12.2 Instruments and Appliances

**12.2.1 CSIO —** The following electronic/electrical instruments were developed : Medical instruments—(i) *Transistorized Stimulator*, using all indigenous components which provides rectangular pulses of controlled amplitude, frequency, duration and polarity; it can be widely used in physiological and neurological studies; (ii) *R. F. Isolation Unit*, suitable for use between a stimulator and the stimulating electrodes to reduce artefact to a minimum when recording; (iii) *Low Level Pre-amplifier*, used for medical purposes, is double ended, a.c. coupled with high common mode rejection and high input impedance; (iv) *Pulse Monitor* (transistorized, frequency range, 6-240 pulses/min.), designed for application in cardiotachometry; (v) *Ionic Decalcifier*, suitable for study of the calcium content in a bone sample; (vi) *Telethermometer*, an electrical thermometer for use in biological field, suitable for oesophageal, rectal, cutaneous and general use; the temperature can be recorded from a distance at several points without disturbing the patient; (vii) *Blood Drop Chamber and Counter*, a photo transistor drop chamber and counter suitable for use in hospitals; (viii) *Cardiac Pace Maker*, is used to activate the dormant heart in case of ventricular standstill by providing controlled electrical pulses both externally and internally. Laboratory type instruments—(i) *Stabilized D. C. Power Supply*, provides output from zero to 30 V. offering low ripple content and is highly regulated with low output impedance; it is a very useful unit for research laboratories for conducting experiments on transistorized circuits, especially pulse circuits and low-level amplifiers; the indigenous content of the components used in the instrument is 98 per cent; (ii) *Preset/Counter*, widely used in counting, batching and packaging equipment; any desired number up to 1000 can be pre-selected; it can also be used as counter and the developed model is capable of counting up to $10^4$ counts/sec. with provision for extending it to enable the instrument to pre-select any number up to $10^6$ and count at the rate of $10^6$ counts/sec., by simply adding a few more decades of the type used; the instrument is completely transistorized and uses all indigenous components except neon indicators which barely form 5 per cent of the total cost of components used; (iii) *Counter/Frequency Meter*, a versatile instrument for accurate measurement of frequency (0 to 2 Mc/s.), and counting of regular or random electrical

r.p.m., pressure, flow, etc., using suitable transducers so as to present these parameters as electrical signals falling within the frequency and voltage range of the counter; provision can also be made for measurement of time interval, period and frequency ratio of two signals; the instrument is completely transistorized using all indigenous components except the neon indicators which barely form 3 per cent of the total cost of the components used; and (iv) *Decade Scaler*, is a general purpose scaler that can be used to count and register the number of electrical pulses arriving in a regular or random fashion over a period of time; it can register the number of emitted particles or events in any dynamic system by use of suitable transducers; the instrument is completely transistorized and uses all indigenous components except neon indicators; (v) *Low Level Transistor Amplifier*, can be used as pre-amplifier to increase the sensitivity of ordinary oscilloscopes and VTVM and to amplify very low signals. Industrial process and control instruments---(i) *Multipoint Temperature Indicator*, indigenous components (98%) for measurement of temperature at various points simultaneously, employing one common indicator in conjunction with various resistance thermometers; the range of temperature measurement is 0 to 600°C. and 0 to 200°C.; (ii) *Differential Thermometer* for measurement of temperature difference directly between two points (range 0°-50°C., 50°-100°C., and 0° to 100°C., this thermometer has a wider range of applications in industry, particularly in certain types of chemical plants where it is important to measure the change which takes place in the temperature of the reacting substances at each stage; (iii) *Electronic Temperature Controller*, a mains operated on-off device for automatic control of temperature within the range of 20°-150°C. having an accuracy of $\pm$ 0.04°C.; (iv) *Indicating on-off Controller/Two-point Controller*, for use in conjunction with pyrometric milli-voltmeters and any other type of panel mounting type of indicating instrument; a transistorized model designed both for a.c. mains and 15 V. battery, using indigenously produced germanium transistors, this instrument can be safely used up to an ambient temperature of 60°C.

12.2.1.1 Designs for the following *Optical Components/Instruments/Prototypes* have been completed : components—(i) *Collimator Objective*, relative aperture f/10; focal length 1000 mm.; having very low coma and well corrected for marginal spherical aberration; it is designed for use in a bench type precision focometer; (ii) *Collimator Objective*, focal length 178 mm.; clear aperture 29 mm.; achromatic doublet having very low coma intended to be used in a laboratory spectrometer; a variation of this system is suitable for use with nearly monochromatic light and is better corrected for spherical aberration and coma; (iii) *Collimator Objective*, focal length 610 mm.; clear aperture 50 mm.; the system, a cemented doublet with three equi-convex and one plane surface, is intended to be used in a student type spectrometer; (iv) *Huygenian Eyepiece*, magnification 10×, this has been designed as a part of the CSIO's objective to develop a full line of microscope optics in the country; the design is to be used with an objective corrected for a standard mechanical tube length of 160 mm.; (v) *Huygenian Eyepiece*, magnification 15×, another in the series of microscope optics being developed. Instruments (i) *Optical Spherometer*, an optical bench type set-up for accurate measurement of the radii of curvature of curved surfaces (overall accuracy better than 0.05 mm., in the radius of curvature measurement); concave surfaces of any radius can be measured by this device and for convex surfaces, however, the range is limited to 50 mm.; (ii) *Corneal Loupe Magnification* 10 ×, a Hastings' type triplet with an effective aperture of 12.5 mm. and a working distance of about 23 mm. fitted into a metal mount with a folding cover;

for the users' trial; and (iii) *Retinoscope*, plane and concave mirror type; Prototypes, prototypes of 10× micro objective and epidiascope objective (CSIO designs) comparing well with imported samples.

12.2.1.2 The following *Mechanical Instruments/Equipment* have been developed : (i) noiseless gas burner for glass-blowing; (ii) hand torch screw on ribbon type burner suitable for lathework in glass-blowing; (iii) micro electrode puller; (iv) a single spindle, power driven, medium size grinding and polishing machine for lenses, with continuously variable r.p.m. range especially suited for production of precision optics such as camera lenses, binocular objectives; and (v) a 4-spindle motor operated, lens polishing machine which can be operated at four different speeds ranging from 54 to 187 r.p.m.

**12.2.2 NPL —** Design and development of prototypes of 10 cm. reflex klystrons has been completed.

A 15 cm. aperture Fizeau interferometer has been fabricated and is in use for testing of optical components. A large number of optical components like optical test flats, test plates have been fabricated. A simple interferometric method making use of the reflected system of the fringes of superposition, has been developed, for testing the equality of thickness of two plane parallel glass plates. The method has adequate sensitivity for the determination of a difference of (lambda)/10 in the optical thickness of the two plates.

12.2.2.1 Experimental work has been completed on a new inverting interferometer for testing spherical mirrors and collimator lenses.

**12.2.3 NGRI —** Instruments such as d.c. earth resistivity meter, proton precision magnetometer, electromagnetic induction prospecting units, crystal controlled power supply and timer, magnetic susceptibility meter, single channel direct travel time-indicating shallow refraction seismic apparatus are being developed at the Institute and prototype units constructed.

12.2.3.1 Geophysical instruments such as hammer type shallow refraction seismograph, flux-gate magnetometer and a few others are being designed and fabricated.

## 12.3 Geophysics and Oceanography

**12.3.1 NGRI —** Construction of a Seismological Observatory at the NGRI site (17° 25′ N : 78° 33′E) is nearing completion. Three short-period Benioff seismographs, one long-period Press-Ewing seismograph and Crystal Chronometer obtained from abroad will be installed in the Observatory shortly.

12.3.1.1 Intercept times of the longitudinal waves recorded by the Seismological observatories at Calcutta, Shillong, Chatra, New Delhi and Dehra Dun have been analysed for two sets of earthquakes — one with epicentres south of Himalayas and the other with epicentres north of Himalayas. Results are being analysed.

12.3.1.2 Studies of several earthquakes records from different observatories have revealed a crustal thickness of about 30 km. under the Indo-Gangetic plains and the presence of [illegible]

12.3.1.3 Studies on Upper Mantle Structure in the Indian Subcontinent from the 'P' wave data of shallow earthquakes are under progress. Travel time curves for 'P' waves have been plotted and they show indications of two velocity discontinuities in the first 1000 km. of the Upper Mantle. The data are being analysed statistically to fix properly the position of these discontinuities with proper estimates of the velocities.

12.3.1.4 Long range seismic refraction shooting for crustal studies in collaboration with other organizations is being planned.

12.3.1.5 A Magnetic Observatory has been established and geomagnetic elements (H, Z and D) are being recorded continuously since December 1964. The Observatory started functioning on a routine basis just in time to join the cooperative observational programme for the International Quiet Sun Year.

12.3.1.6 A study of behaviour of H & Z baselines with changes of humidity was made. It is seen the baselines have a tendency to vary inversely with humidity percentage. The study is being continued over a year to establish this suspected relation conclusively.

12.3.1.7 A Geoelectric Observatory for studies of rapid variations of earth's electromagnetic field has been established at Choutuppal near Hyderabad. It is planned to instal a set of magnetic micropulsation recorders (induction variometers) for recording simultaneously the rapid variations of the geomagnetic field at the same speeds as those of earth currents. The latter equipment is being designed and built at the Institute.

12.3.1.8 About 2800 gravity stations have been established covering such geologic units as the Dharwars and Cuddapahs. During the field surveys, some important gaps in the southern most part have been filled. Detailed surveys with one mile station spacing along two profiles in Cuddapah basin and with one furlong station spacing along a part of the 14th parallel are completed. The Bouguer anomalies were computed and the contour maps have been prepared.

12.3.1.9 Interpretation of the isostatic anomaly profiles along 13th and 14th parallels is completed. These profiles and also the ones along the 9th, 10th, 11th, 12th and 15th parallels show maximum isostatic anomaly in their middle part. These maxima correspond to the plateau regions of the Peninsular Shield. It is not clear whether the crust is thinner in this region due to upward movement of the mantle or it is heavier due to some physico-chemical changes taking place at the crust-upper mantle boundary.

12.3.1.10 The Bouguer anomaly map of the Godavari and Satpura basins is interpreted and a possible sedimentary thickness of 3.1 km. in Godavari basin and 3.8 km. in Satpura basin has been estimated.

12.3.1.11 Velocity and attenuation measurements in a number of rocks at atmospheric pressure and temperature and at megacycle frequency range have been made. Velocity values have been correlated with density, porosity, mafic content and grain size in Deccan Traps, Ultramafic rocks, pyroxenites and other related Upper Mantle Rocks. Attenuation measurements have also been made under varying pressure and a steady decrease in absorption has been noticed with the application of

12.3.1.12 Studies on the fracture process that takes place in a solid body subjected to simple compression using ultrasonic techniques have been carried out. An experiment has been set up to study elastic pulses that are generated when a fracture develops in a rock specimen. Experimental work is in progress to study the frequency, energy and recurrence rate of these pulses during the period preceding the final destruction of the rock sample.

12.3.1.13 An apparatus has been designed and fabricated to determine the elastic constants of a rock sample under simple compression. A chamber for hydrostatic pressure up to 5 kilobars is under construction to study the elastic properties of rocks under high pressure.

12.3.1.14 Sixty samples of Tirupathi red sandstones of lower Cretaceous age were studied. The samples showed very stable directions of magnetization as revealed by various stability tests. The results from all sites are consistent with the position of India in the southern hemisphere during Lower Cretaceous times thus supporting the hypothesis on Continental Drift.

12.3.1.15 Fifty-four samples of Kamthi red sandstones of Permian age from Godavary valley were studied. These samples were also found to be very stable. The mean direction of magnetization was found to be D=N 306°E, I=−50° (up). The results are consistent with the position of India in the southern hemisphere during Upper Permian times when Indian land mass could have been a part of the Gondwan a land consisting of continents of Antarctica, Africa, South America and Australia.

12.3.1.16 Nearly 500 rock samples of various Gondwana formations, Talchir shales, Himgir formation, Iron-stone shales, Gondana dykes, Panchets and Barakars were collected from Gondwana, coalfields of Mahanadi and Damodar valleys for Palaeomagnetic studies.

12.3.1.17 Geothermal gradients were measured in several oil wells in Kalol, Cambay and Ankleswar oilfields. Highest gradients have been measured in the Cambay basin so far in India. Geothermal gradients were measured in several bore holes at Rakha mine and at Bhatin and Narva Pahar along Singhbhum Thrust Zone up to a maximum depth of about 300 m. The gradient in the area was found to be of the order of 13°C./km. which is much lower than the gradient observed in Mosabani Copper Mine (19.4°C./km.). The causes for these regional variations are being studied. Geothermal gradients were measured in several bore holes drilled by Singareni Collieries and Geological Survey of India in Bellampalli coalfields (A.P.) up to a maximum depth of about 610 m. The gradients found are being examined.

12.3.1.18 Thermal conductivities of sixty-one samples of quartzites and phyllites from three bore holes in Khetri Copper Belt were determined for evaluating terrestrial heat in the area.

12.3.1.19 Thermal conductivities of twenty-three samples of grey sandstones and carbonaceous shales from different bore holes in Bellampalli coalfield were determined for estimating heat flow in the area.

12.3.1.20 Several factors which contribute to the variations of magnetic field observed at the surface of the earth have been studied. One of the most important factors is the distortion of toroidal magnetic field by the

generated by the interaction of the convectional fluid motion and the toroidal field ($T_M°$) has been calculated.

12.3.1.21 The stability of $S_{30}$ geomagnetic main field has been investigated considering it as a first order perturbation of Bullard and Gellman's dynamo. The pressure equation has been solved and the results are being interpreted.

12.3.1.22 Deformation of seismic pulse shapes by media of moderate and rapid velocity variations has been investigated. This study is an important step towards a more effective utilization of seismic records.

12.3.1.23 The problem of propagation of Love waves under conditions of anisotropy and inhomogeneities represented by (i) power law distributions, (ii) exponential variations, (iii) hyperbolic variations of rigidities, velocity and density has been formulated. This has been investigated and results are being interpreted.

12.3.1.24 The problem of propagation of Rayleigh waves in an inhomogeneous layer lying between two semi-infinite homogeneous media having different elastic constants has been solved. The elastic parameters are supposed to vary quadratically with depth. The period equation for finding dispersion relations has been derived.

12.3.1.25 A new interpretation to the results of E.M. model investigations of Lowrie and West has been given on the basis of the theory of 'negative screening'. The problem of electromagnetic response of a stratified biaxial anisotropic medium to a magnetic dipole has been studied. The pertinent condition has an important bearing on the form of the solution.

12.3.1.26 Electromagnetic response of a perturbed sphere having a boundary of the type $\gamma = \gamma_o [1 + \theta_u (\theta)]$ has been studied and numerical computations are under progress.

12.3.1.27 A theoretical possibility has been established which provides a basis for simulating conductors of directional inhomogeneity by means of spatial deformations in the electromagnetic model experiments.

12.3.1.28 The study of 'non-linear transparency' of pulse forms has revealed that even under perfectly elastic conditions, the seismic pulse shapes get deformed in a manner predominantly dependent upon the velocity variations in the media they traverse. This should help in a more effective utilization of seismic records.

12.3.1.29 Love wave propagation in an anisotropic, inhomogeneous layered structure has been studied elaborately. The results are of great value in delineating the finer structural details of the earth as well as in seismic prospecting where deep layered structures are considered.

12.3.1.30 A gravity survey for chromite was carried out at the request of *Tata Iron & Steel Company* over its leased area in Sukinda, Orissa.

12.3.1.31 Considerable amount of work has been done in expanding the method of continuation to interpret gravity, magnetic, electrical and electromagnetic data. Convergence conditions for various simple geometries have been worked out.

12.3.1.32 A short-duration experimental resistivity survey for location

country rocks and pegmatites is under evaluation for using them as guides for the search of new pegmatite deposits.

12.3.1.33 A method of interpretation of magnetic data collected over rough topography has been worked out.

12.3.1.34 A method of interpretation of gravity and magnetic data, collected in vertical shafts or bore holes has been worked out.

12.3.1.35 Gravity, magnetic and self-potential surveys were conducted in the Ingaldhal area, Mysore, for the exploration of sulphide ore bodies. Detailed magnetic surveys were conducted in the Kudremukha area of Mysore State at the instance of National Mineral Development Corporation for exploration of magnetite quartzites.

12.3.1.36 Problems of geophysical exploration for ground water have been taken up. A few resistivity meters which can be successfully employed for ground water surveys have been constructed. A simple seismic refraction unit has been developed for determination of the depth of hard bed rock. Both these geophysical instruments have been constructed with indigenous components.

12.3.1.37 An experimental Proton Magnetometer survey for location of buried archaeological sites in parts of the sandy beach areas of Kaveripattanam has been undertaken.

**12.3.2 NIO —** The oceanographic research activities are at present carried out in the following four divisions of the Institute. Planning and Data Division at New Delhi, Indian Ocean Biological Centre, Physical Oceanography and Biological Oceanography Division at Ernakulam.

12.3.2.1 Receipt and quality checking of the physical and chemical oceanography data collected during the International Indian Ocean Expedition by INS KISTNA and R/V VARUNA during 1962 and 1963 have been completed at the Data Division. The quality of the data has been ensured by preparing vertical distribution charts in respect of a few parameters and studying them. After the data have been corrected, they have been copied on standard cards and sent to World Data Centre 'A', Washington, USA. The printout of these data as well as computed values in respect of sigma-t, specific volume anomaly, has been received from them.

12.3.2.2 The data centre is also engaged in designing a suitable format for recording data on board the research ship. This includes Decksheets, winch operation cards, etc. Work has also been taken on hand for preparing T. S. Emelopes for 5-degree squares in the various areas of Arabian Sea and Bay of Bengal.

12.3.2.3 The sorting of plankton samples according to the standardized procedure was continued in the Indian Ocean Biological Centre. Out of a total of 2188 samples, 336 samples were sorted during the year. Taking into account 1213 samples sorted earlier, the number of samples unsorted were 639.

12.3.2.4 The following activities are in progress as an initial step towards an intensive plankton research programme : Subsorting of Amphipoda, Decapoda and Anthozoan larvae to family and of larval fishes to order and a few to families, identification of pelagic polychaetes, Heteropoda (exclusive

12.3.2.5 Progress has been made in the processing of data for the General Properties Atlas. Compilation of complete data under station lists for one section has been finalized. Total Biomass charts have been completed and preparation of distribution charts for fish larvae and copepoda is in progress.

12.3.2.6 Processing and analysis of hydrographic data collected under the Indian Programme of International Indian Ocean Expedition, physical and chemical studies of shelf sediments and backwaters at Ernakulam and studies on coastal and nearshore oceanography and on bathymetry and scattering layers are being pursued under the physical oceanography programme. The distribution of shelf sediments in respect of grain size, total phosphorus, calcium carbonate and organic matter has been studied. It has been found that (i) the coasts of Cochin and Alleppey are rich in phosphorus while Mangalore and Karwar coasts are uniformly poor with Bombay coast coming in between; (ii) calcium carbonate contents in sediments decrease from north to south along the west coast and increase with depth along the shelf; (iii) sediments in inner shelf and continental slope are characterized by a higher content of organic matter while those in the region in between are relatively poor.

12.3.2.7 Study of the coastal and nearshore oceanography showed that beaches were subjected to erosion during the south-west monsoon and that there was a build-up during the remaining period of the year. Theoretical studies on wave refraction near the coast at Thottapally were carried out for waves of different directions and periods. Surface, subsurface and bottom currents were studied using self-recording current meters, floats, etc.

12.3.2.8 It has been inferred from studies on the scattering layers off the Konkan coast that reflection from the shallow scattering layers may not be due to a physical discontinuity. Detailed studies of the profiles of submarine canyons off Coromandal coast have also been undertaken.

12.3.2.9 Work on hydrography and primary productivity of Cochin backwaters has progressed well. Studies on changes in physical, chemical and biological factors and the influence of tide on some of the factors have been made. The value of primary productivity of Cochin backwaters determined by $C^{14}$ and oxygen methods has been found to vary between 100 and 1000 mg./m.$^3$/day. A relationship has been established between primary production due to solar radiation and chlorophyll. It has been found that (i) the phytoplankton crop of backwaters was largely made up of diatoms and dinoflagellates while 300 plankton included a variety of forms; (ii) the total zooplankton volume was directly correlated with changes in salinity; and (iii) the microbenthos of backwaters included three dominant groups, bivalves, polychaetes and gastropods and the meiobenthos, foraminiferans and nematodes; (iv) the benthic biomass was greater in the marine zone than in the fresh water zone; and (v) the bacterial population of backwaters which was generally very high reached its maximum during the monsoon and post-monsoon months.

12.3.2.10 Some aspects of the physiology of osmoregulation in crabs have also been studied.

12.3.2.11 A two-week oceanographic cruise was conducted into the

## 12.4 Mechanical Engineering

**12.4.1 CMERI —** The Institute has taken up a number of projects for capital machinery development on request. As a result of increased demand for product evaluation and advisory services, facilities have been extended from the three research development centres at Poona, Ludhiana and Madras. Arrangements are being made for effective use of the concepts in saving structural steel by the development of light structures in industrial projects.

12.4.1.1 An intensive drive in the cable making machinery project has been made and the prototype loop paper insulating machine and bunching machine have been completed and tested. Machines for stranding, high speed twisting, trunk paper insulating, ten head loop paper insulating and a continuous resistance annealer are getting ready for trials. Designs of ten other machines required for the project are in hand.

12.4.1.2 Prototype of the scooter which has been developed is under extensive trials and improvements in designs are under way. The design of a 50 cc. moped is in the final stages. The prototype engine for the moped is under developmental trials.

12.4.1.3 Fluid couplings for industrial transmission use have been developed in collaboration with *Westinghouse Saxby Farmer Pvt. Ltd*, Calcutta. The first hydraulic dynamometers for testing I.C. Engines developed by the Institute would be ready in March 1967.

12.4.1.4 Development of instruments using mostly indigenously available components to improve quality and productivity in the engineering industry is an important activity of the Institute. In this context, the following instruments have been developed : Low pressure pneumatic gauging system, dynamic balancing machine for balancing rotary elements like shafts, rotors of motors, impellers, etc. and various controls like eddy current couplers, timing relays required for cable machines under development. The prototype of an electronic comparator has been tested and modified suitably. Portable hardness testers and dial gauges are under development. The dye-penetrant developed for finding surface flaws in metallic and non-metallic materials would be in the market shortly.

12.4.1.5 A method of brazing aluminium tubing under investigation has shown promising results. Successful application of this method would mean replacement of copper in heat exchangers for refrigeration, air-conditioners, etc.

12.4.1.6 An IBM 1620 computer with 60 K memory has been installed and is in use. Some of the existing programming languages like, FORGO, SPS, etc. have been modified to suit the requirements of the Institute and other users of the computer.

12.4.1.7 As a result of increased demand for product evaluation and advisory services such facilities are being extended from the three research development centres at Poona, Ludhiana and Madras.

**12.4.2 NPL —** The design and fabrication of a 3000 kg. dead weight machine has been completed. The machine is now being used for the calibration of load measuring devices. This is the first time that a standard of force with this accuracy has been set up in this country. Such an equip-

12.4.2.1 Work has been started in the Laboratory on the design and fabrication of high pressure equipment for hydrostatic extrusion of metals and material testing. The design and fabrication of an extrusion press with a pressure of 50,000 lb./sq. in. has been completed, and several extrusions of lead have been made.

## 12.5 Electronics

**12.5.1 CEERI —** A number of moving coil microphones as per the improved design were fabricated and tested. The improvements consisted in the modification of the magnetic circuits; selection of diaphragm material, its compliance and dimensions to achieve appropriate diaphragm resonance; incorporation of adjustable acoustic resistance to control the amplitude of the diaphragm resonance; and simplification of the overall design for ease of fabrication and assembly.

12.5.1.1 A new design of a condenser microphone, using Melinex as diaphragm material in a novel clamping arrangement, was evolved. The frequency response of the condenser microphone was thus extended beyond 18,000 c/s. One unit wa ssent to CMERI for use in the analysis of machinery noise. Another unit was sent to the Research Department, All India Radio, for trials.

12.5.1.2 A tone arm suitable for the ceramic pickups (developed at this Institute) and a turntable with three speeds ($33\frac{1}{3}$, 45 and 78 r.p.m.) have been designed and fabricated. The tone arm is designed to have a low tracking weight with an offset angle of 26° and an overhang of 0.5 in.

12.5.1.3 A critical study was made of the three important aspects of magnetic tape recorders, viz. (i) electronic circuits, (ii) tape deck, and (iii) tape heads, to evolve a simple and an easy-to-fabricate design using indigenously available materials. Target technical specifications were drawn up. A record-play-back amplifier using electron tubes with equalization characteristics according to NAB standards (time constant of 100 micro-seconds for tape speed of $7\frac{1}{2}$ in. per sec.), and a bias/erase oscillator of 50 kc/s., using electron tubes, to give bias/erase current at low distortion were evolved. Testing of the electronic circuitry with the available tape deck and tape head showed that the overall frequency response was 50 to 10,000 c/s. (within $\pm$ 2 db.).

12.5.1.4 A record- and play-back amplifier conforming to NAB standards has been designed and developed, using indigenous transistors. The overall frequency response of the system using the available tape deck and tape head is 50 to 10,000 c/s. (3 db. points). A first prototype model of the tape deck was designed, fabricated and tested.

12.5.1.5 A study of vocoder systems and their recent trends was made and overall system specifications were drawn up. A number of sub-units of the encoder, such as band pass filter, main and auxiliary constant volume amplifiers, channel filters, and 25 cycle active low pass filters have been completed.

12.5.1.6 The design of the television receiver (conforming to CCIR standards) was frozen and a few prototypes were made and tested. Various jigs and tools for batch-production were developed and fabricated.

incorporated, depending upon the signal strength available at the receiving station. The characteristics of the antenna with one reflector and two directors are: Gain 4.5-6.3 db., VSWR with respect to 300 ohms—line better than 2.5.

12.5.1.8 A laboratory model of the television pattern generator was developed for servicing and alignment of television receivers. The design was based upon mostly indigenously available transistors and other components.

12.5.1.9 Broadboard models of television camera and low-power television transmitter were built.

12.5.1.10 Design of the production-worthy model of the standard R. F. Signal Generator was finalized and four models were tested at the Chief Inspectorate of Electronics, Bangalore. Necessary modifications were incorporated in the design.

12.5.1.11 At the request of the Federation of Associations of Small Scale Industries and the Development Commissioner, Small Scale Industries, a low-cost medium-wave transistorized radio receiver was designed and developed, using indigenous components supplied by the Federation. The performance specifications of the receiver were generally better than the minimum IS specifications.

12.5.1.12 An engineered model of the Digital Frequency Meter covering a frequency range of 30 c/s. to 1 Mc/s. was made and handed over to *Oriental Science Apparatus Workshops*, Ambala Cantt, for commercial production.

12.5.1.13 Based on a detailed mathematical analysis involving the derivation of the describing function of a permanent magnet d.c. servomotor and feasibility study regarding their use in instrument servo-mechanisms, a transistorized fast response servo-operated pen recorder was developed and its performance was evaluated.

12.5.1.14 Laboratory models of the T.V. service oscilloscope (type A.D.C. 5 Mc/s.) and general purpose high speed oscilloscope (type B.D.C. 10 Mc/s.) were completed.

12.5.1.15 For remote control of television cameras, two versions of a remote position control servo-mechanism, one using vacuum tubes and the other using transistors were designed and fabricated.

12.5.1.16 Work on the development of VHF silicon planar transistors was continued with a view to improving its characteristics and yield. The average characteristics attained so far were: Power dissipation, 5 W.; breakdown voltage, 18 V.; leakage current, 1 $\mu$A.; cut-off frequency, 15 Mc/s.

12.5.1.17 Varactor diodes were developed with cut-off frequency up to 10 Gc and breakdown voltage of 7 V. The capacitance of the diodes varies from 2.5 pF to 25 pF at zero bias. Reproducibility at various stages of the process was statistically analysed.

12.5.1.18 Some of the facilities for fabrication of integrated circuits were established, and individual components like transistors, diodes, resistors and capacitors were fabricated on a silicon slice.

Its performance was improved by using platinum plated molybdenum for the grid instead of molybdenum used hitherto.

12.5.1.20 The behaviour of electron beams in a magnetic field increasing as $Z\alpha$ ($\alpha \gtrless 1$) was theoretically studied. The results obtained were found to be quantitatively similar to those for the exponentially increasing magnetic field.

12.5.1.21 A crossed-field backward wave oscillator was developed and successfully tested. Power supply for driving the oscillator was developed and fabricated.

12.5.1.22 A new type of coupler was designed and fabricated for coupling the input and output of beam-plasma amplifier. The coupling device employs the concept of launching surface wave types of modes over plasma columns and this did not involve the use of minute and intricate slow-wave structures or cavities. Coupling losses as low as 3 db./ coupler have been attained over a frequency range of 1 : 1 : 3.

12.5.1.23 Experimental investigations on noise in microwave tubes have shown that the noise output from crossed-field guns can be reduced by a large factor by introducing a slight magnetic field in the lateral direction at the cathode.

**12.5.2 NPL —** The Development-cum-Production of Electronic Components Unit of the Laboratory has concentrated its activities mainly on the following components: (1) Soft ferrites, antenna rods and coil cores for the entertainment industry for operation on short waves up to 20 Mc/s.; (2) (i) Large scale production experiments on Mn-Zn ferrite composition which can be used by the entertainment industry for radio receivers. This project has been successful and it has been possible to completely eliminate the use of nickel which is an imported metal, for medium ferrites; (ii) Intensive experiments on high permeability Mn-Zn ferrites used in the telecommunication industry has progressed well and the toroidal samples have shown permeability and other characteristics comparable in every way to that of the most recent 'Professional' ferrites made abroad. Pot cores are now being made in quantities for tests by the *Indian Telephone Industries*; (3) Soft ferrites for operation at microwaves have also been produced to cover gynemics up to 10 Gc/s. These have been used in microwave devices; (4) The work carried out on piezoelectric compositions is now concentrated in making intermediate frequency filters. Large batch samples have been prepared and all their characteristics have been measured and found to be satisfactory. Samples have been sent for trials to some selected receiver manufacturers; (5) (i) In the field of technical ceramics the work has been concentrated on production in large quantities of trimmer parts such as bases and rings. These are being supplied regularly to the radio industry. Further development work has been done on ceramic studies for tuning condensers; (ii) *Telefunken (Ltd)*, a German firm, have expressed desire in the ceramic compositions that have been developed for high frequencies and have given samples of semi-variable ceramic trimmers. There is a possibility that the firm may take over the process in their new factory which is coming up near Delhi for export of ceramic trimmers as well as for their own use; (iii) Ceramic compositions suitable for use as microwave absorbers have been developed.

## 12.6 Civil Engineering

in areas of moderate rainfall has further been adopted in constructing Mehsana-Bodla Road in Gujarat State, Badagaon-Sihonia Road in Madhya Pradesh and Sriganga Nagar-Sahibawala Road in Rajasthan, as a measure of development. The technique has further been accepted for large scale development in some other States in their Development Projects under the Central Assessment Committee.

12.6.1.1 The following roads have been constructed under the technical supervision of the Institute adopting soil gravel stabilization technique developed at the Institute: Merta City-Pandu Road (Rajasthan), Amruthur-Yedvani Road (Mysore), M. C. Road-Yallal (Andhra Pradesh) and some roads in Punjab and Madras States.

12.6.1.2 The use of black cotton soil stabilized with lime as a sub-base for the construction of water bound macadam road has been adopted on certain length of roads in Madhya Pradesh and Uttar Pradesh. The technique of stabilizing moorum with lime for use as base-course to replace rubble soling in the construction of roads has been adopted in some roads in Andhra Pradesh. On the recommendations of the Central Assessment Committee, the use of black cotton soil and moorum stabilized with lime as sub-base and base-course respectively in the construction of water bound macadam roads has been accepted for a length of about 300 miles by various States for immediate adoption. For the construction of roads in areas of high water table, the use of local soil stabilized with lime as a sub-base or base-course in water bound macadam roads is fast finding favour with the construction engineers. The technique has been adopted on some roads in Uttar Pradesh and Punjab.

12.6.1.3 To economize in the cost of construction, surveys of some road lengths in Rajasthan and Gujarat were carried out. The surveys indicate that in a large majority of cases, considerable savings can be effected in the road construction costs by using materials available close to the alignment of the road.

12.6.1.4 With a view to formulating workable specifications for compaction of road embankment in a scientific manner and to work out economics and achieve speed of construction, field trials have been carried out and conclusions were drawn for the prevailing conditions.

12.6.1.5 A technique correlating the identification of highway materials including soils by air photo interpretation and by ground survey has been adopted for a stretch of about 250 sq. miles area with the object of explaining its potentiality for expeditious material survey.

12.6.1.6 Bituminous mixtures as laid on the road are subjected to both compressive as well as shearing stresses. Most of the tests which are normally employed in the design of bituminous mixtures are mainly compressive and empirical in nature. As the shear strength of bituminous mixtures is only about one-sixth of their compressive strength, great precautions are necessary while designing the mixtures to provide adequate shear resistance. With a view to assess the shear strength as well as strength under repetitive loading, tests like open and close triaxial are being conducted on a set of standard bituminous mixes.

12.6.1.7 Earlier investigations had shown that gap graded aggregates can be used successfully to yield stable and dense asphaltic concrete mixtures.

can be made best use of for economic design of asphaltic concrete mixtures. Also, fly ash can be used as a filler. Such scientifically designed gap graded mixtures, using about 45-50 per cent of 3/4-3/8 in. size aggregates only as coarse aggregates were found to compare fairly well with the ideally graded mixtures as regards the various physical properties.

12.6.1.8 A design for portable air landing mat for use on emergency and temporary airfields has been evolved. The design based on the use of M. S. tubes welded together to form individual planks, conforms to the governing criteria laid down for the development of such mats by the Army Headquarters and is likely to be about 50 per cent cheaper than the currently accepted designs using alloy aluminium as material for construction.

12.6.1.9 Construction of a test track comprising two experimental prestressed concrete pavement slabs 400 ft × 11 ft × 4.5 in. has been taken in hand. This is the first ever prestressed concrete pavement being laid in the country. The use of this technique enables the pavement thickness to be reduced substantially, and the 4.5 in. thick slabs are equivalent in strength to the 7.5 in. thick conventional plain cement concrete pavements. Consequently, considerable saving in cement requirement is possible with this technique, the relative cost remaining more or less the same.

12.6.1.10 Studies on temperature differentials in cement concrete pavements of varying thicknesses in different climatic zones of the country have been completed. The findings from the study are being brought out as a Special Report for use by the Highway and Aviation Departments in the country, as a step towards the rational design of concrete pavements for roads and airfields.

12.6.1.11 A new theoretical study has been undertaken on the kinetic behaviour of rigid pavements under moving loads.

12.6.1.12 Satisfactory performances have been noticed of the experimental test tracks laid in recent years, namely brick-sandwiched concrete stretches (Mathura-Agra Road and M. E. S. Taxi tracks), bamboo-reinforced soil-cement specifications on Rohtak-Gohana Road and composite construction comprising lime-puzzolana concrete underlay with thin cement concrete overlay on Delhi-Mathura Road. These test tracks were laid with a view to substantially economizing the cost of rigid pavement construction.

12.6.1.13 Findings of special significance for paving concrete have been made as a result of the two-year observations on a concrete test track comprising 32 specifications subjected to iron-tyred traffic for evaluation of abrasive resistance of different specifications.

12.6.1.14 Investigations on the use of locally available fine sands in place of coarse sands as specified in the standard specifications have resulted in the following conclusions: (i) fine sands of fineness modulus in the range of 1.0 can be used satisfactorily to make good quality concrete, provided they satisfy other requirements of the specification; (ii) it is normally more economical to blend coarse and fine sands in more or less equal proportions than to use coarse variety alone; and (iii) the economy is enhanced if concrete is gap graded.

12.6.1.15 Fundamental work on rehydration characteristics of burnt

12.6.1.16 Detailed investigations have been carried out on about 650 miles of roads which have been constructed in the States of Maharashtra, Orissa, Bihar and West Bengal with credit from International Development Authority, and on which some shortcomings were found. The investigations included such aspects as evaluation of riding quality, structural quality of pavements and examination of design and construction practices for pavements, shoulders, culverts and minor bridges and rotary intersections. Recommendations have been framed in the form of a report.

12.6.1.17 Traffic and transportation studies were conducted in (i) Calcutta in connection with Greater Calcutta Development plan, (ii) Bangalore for Bangalore Metropolitan Area, (iii) Hyderabad with a view to suggest suitable traffic engineering education and enforcement measures, and (iv) *Hindustan Steel Plant Ltd*, Bhilai township and factory area with a view to assess the inadequacy in the present traffic and transportation facilities.

12.6.1.18 Work on the study of the economic loss on account of traffic delays at road-rail grade crossings and need for provision of grade separation at these crossings has been made in Delhi. The economic loss has been estimated as high as Rs 840 per day on one of these crossings. Cost benefit analysis for determining the traffic volume warranting provision of grade separation has also been carried out.

12.6.1.19 A study for predicting traffic and transportation demands in Delhi for 1981 has been undertaken at the request of the Planning Commission. The assignment of future traffic on road network of Delhi has been completed. Assignment of mass transport trips is in progress. On the basis of the study, a road development scheme for Delhi during the Fourth Five-Year Plan has been worked out.

12.6.1.20 The study of typical landslide problems for the last few years has been made use of for compiling a publication entitled 'Handbook on Landslide Analysis and Correction'. The Handbook defines the limits within which the traditional techniques are applicable and also suggests recently developed techniques suitable under the circumstances in which the traditional procedures are not so effective.

12.6.1.21 Recommendations concerning type of foundations to be adopted for Cargo Jetty No. 5 in Kandla Port have been framed and foundation analysis for designing a suitable type of foundation for Cargo Jetty No. 6 is in progress.

12.6.1.22 Investigations were undertaken on erosion control of embankment slopes by the asphalt mulch technique. The slopes of the approaches of the Azadpur Bridge, Delhi, treated by the above method, have been performing satisfactorily.

12.6.1.23 Experiments on using jute mesh on embankment slopes and hillside slopes for erosion control have given promising results.

**12.6.2 CBRI —** Over six lakhs bricks of good quality were manufactured at Indore in a full sized kiln using coal ash and 'grog' as opening materials. Modular size bricks of high quality were also produced on an experimental basis. Examination of soil samples from Tripura State for their suitability for manufacturing paving bricks and brick aggregates has shown that the

process was developed for producing bricks from 'Jhori' soils of Chattargarh, Rajasthan. The bricks produced have a crushing strength of 55-65 kg./sq. cm. which was considered satisfactory. The quality of the bricks can be improved further by reducing their thickness from 7.5 cm. to 5 cm. The process is expected to be adopted by the Rajasthan Canal Project authorities for the manufacture of bricks. A burnt clay tile (weight, 11 kg. and crushing strength, 105-160 kg./sq. cm.) which helps prefabrication of floor and roof elements has been developed to improve the existing practice of reinforced brick roof construction.

12.6.2.1 Clay deposits around Roorkee have been surveyed for locating sources for large scale supply of raw material for producing bloated clay aggregate used in the production of lightweight concrete. Optimum conditions for bloating of clays have been determined. Similar surveys have also been carried out around Varanasi, Kanpur, Lucknow and in Tripura State. Suitable mix compositions of cement and retted coconut pitch have been developed for producing lightweight concrete in the density range 432-528 kg./cu. m. The thermal conductivity of the coconut pith cements compared favourably with that of costly insulating materials. Distempers incorporating polyvinyl acetate resin emulsion and chalk and 'Hiramji' as base materials have been developed. The distempers possess good brushability and better hiding power compared to commonly used distempers, besides being washable.

12.6.2.2 Pilot plant trials for producing lightweight sintered fly-ash aggregate have been carried out in a rectangular masonry clamp (1.5 tonnes capacity) with a stationary grate. The output efficiency has been found to be about 90 per cent.

12.6.2.3 The bearing capacity of boulder deposits (grain sizes 0.5-2.5 in.) has been studied on large models in the laboratory.

12.6.2.4 An inexpensive volume change apparatus has been designed and fabricated to replace imported apparatus used in the measurement of volume changes in the triaxial tests for soils. Volume changes of the order of 0.1 ml. can be made with the apparatus.

12.6.2.5 To eliminate the time lag between the casting of under-reamed piles and subsequent placement of beams and superstructure, attempts have been made to prefabricate the beams so that even in rainy season the work on superstructure can continue. These beams also help in tying up the piles and preventing any lateral movement in unloaded piles.

12.6.2.6 A simple and fast method of boring has been developed to help in sub-surface soil exploration. The apparatus used for the method, though manually operated, is as efficient as any other mechanized appliance. It does not require any costly equipment and can be obtained for less than Rs 1000. The apparatus has been found useful by the industry under actual field conditions.

12.6.2.7 Data on the availability of daylight on clear days at Roorkee have been analysed and presented in a form which can be used for the prediction of indoor daylight.

12.6.2.8 Comfort in buildings in the tropical regions depends very much on natural ventilation, particularly during the post-monsoon period. of buildings were studied in a low pressure wind tunnel designed and fabricated. Several important conclusions were reached.

12.6.2.9 Manpower and materials requirements for single storeyed residential buildings with identical specifications were computed. The results have been expressed in the form of graphs and equations which are simple and sufficiently accurate.

12.6.2.10 A machine for tamping of lime concrete on roofs has been developed. It has a capacity to tamp about 360 sq. m./hr of roof surfaces and weighs about 40 kg. The machine is driven by a 1/4 h.p. electric motor and can be operated by one man. The use of the machine would result in saving in time and ensure better quality control.

12.6.2.11 Studies to rationalize the specifications for foundation of residential buildings have led to the recommendations that a 7.6 cm. thick concrete of any mix will suffice as a levelling course to begin the foundation masonry. Further, from considerations of durability, it has been suggested that the same mortar as specified for the superstructure may be adopted in the foundation masonry also and that the off-sets for widening of the foundation masonry need be concentrated in the lower regions of the foundation only as against the normal practice of taking them up to the plinth. A ten per cent saving in cost in foundation is possible by adopting this procedure.

12.6.2.12 A simple casting process, without any mechanical aids, has been developed to fabricate box type precast units as substitutes for RCC slabs for roofs, etc. Standard tests on individual units and the roof assemblies have yielded satisfactory results. Besides saving in framework, there is a saving of about 16.5 and 12.5 per cent in the consumption of cement and steel respectively as compared to a conventional RCC slab for a 3·7 m. span.

12.6.2.13 Three important aspects of multistoreyed housing developments, viz. (i) densities and number of storeys, (ii) densities and open space criteria, and (iii) solar consideration and block planning have been studied and graphs, tables and charts have been developed to provide the essential planning data for the use of the planners.

12.6.2.14 A study of economic provision of spaces in school buildings has been made by analysing usage in a 5-class room school. The results revealed that during 38 per cent of the time, the activities were conducted outside the school. On this basis it was inferred that it was possible to make 100 per cent use of a 3-class room school.

12.6.2.15 The following studies have been initiated: strength of brick masonry walls with the object of recommending wall thicknesses for different storeys, taking into account stability, shear and bearing considerations for different strengths of bricks; performance of joints in prefabrication system, such as wall-to-wall, floor-to-floor, wall-to-floor in a two-roomed double storey construction on a half-scale model and their handling and assembling techniques such as horizontal casting; assessment of the minimum and optimum dwelling space requirements essential for effective planning and maximum utilization of dwelling spaces; and formulation of design data needed for planning of hospital buildings based on work study observations reaction and opinion surveys and special analysis, to establish location, interrelationship and size of different components including nature and provision of services.

12.6.3 SERC The research activities of this Centre are organized

economical roofing schemes, bridges, concrete technology, steel and light metal structures, structural dynamics, experimental stress analysis and digital computation. An Information and Publications Division has been established during the year.

12.6.3.1 Analysis of multistoreyed frames has become important in recent years on account of increasing trend towards vertical expansion especially in the metropolitan cities. Analysis of such frames for lateral loads, such as those induced by wind and earthquakes, has shown that they are heavy and uneconomical. The answer to this problem is provision of shear walls. Work carried out at the centre on this aspect has resulted in development of methods for studying the interaction of shear walls with the frames and analysis of symmetrical and unsymmetrical coupled shear walls; computer programmes for carrying out the analysis have also been developed.

12.6.3.2 'Lift-slab' technique has been recognized as an efficient, fast and economical means for the construction of multistoreyed buildings. The technique developed in USA is rather sophisticated. A simple system suitable for our conditions has been perfected. In order to gain experience in this form of construction and solving the practical problems involved, an experimental two-storeyed office building was constructed in the campus of the Centre, using a lifting equipment indigenously fabricated. As a result of this experience, the Centre is in a position to supply the know-how and technical guidance necessary for undertaking lift-slab construction.

12.6.3.3 Considerable amount of work has been carried out for development of economical designs for roofing so that they may be used in construction of residential, industrial and storage structures. Large funicular shell roofs have been designed and constructed using bricks. Using this technique a full scale trial of shells measuring 41 ft × 41 ft were built with brick on edge 4.5 in. thick and reinforcement running in two directions at 10.5 in. c/c. and with edge beams of reinforced concrete. This construction on the plan of the buildings of the National Design Institute, Ahmedabad resulted in 30 per cent savings in cement compared to reinforced concrete shells of equal size. Further improvement was effected by construction of a funicular shell 22 ft × 22 ft in plan at the campus of the Centre using only hollow clay block 3 in. thick without any reinforcement but with edge beams of reinforced concrete. A saving of 30-35 per cent both in cement and steel was found to be possible by this means.

12.6.3.4 Standardized bridge beams in prestressed concrete have been designed for I.R.C. loadings, the results of which will obviate the wasteful repetitive designs carried out in various states. This will cause considerable savings in bridge construction.

12.6.3.5 A case study of use of high strength deformed bars using ultimate load methods instead of the present method of use of mild steel bars in reinforced concrete multistoreyed buildings revealed that a saving of 40 per cent in steel would be effected. Consequently, designs of both cold-worked and hot rolled bars have been evolved. *Tata Iron & Steel Co.*, Jamshedpur are expected to take up the manufacture of cold-worked high strength deformed bars in collaboration with the Centre.

12.6.3.6 A new scheme for the design and fabrication of braced domes—an economical means of covering large areas without intermediate supports weight reduction and erective speed. The scheme used is different from the one of subdividing icosahedron adopted for the geodesic domes popularized by Buckminster Fuller of USA.

12.6.3.7 A hemispherical dome of frequency four using aluminium alloy tubular members (diam. 40 ft; weight excluding cladding, 575 kg.; 488 kg./sq. in. of space) has been fabricated and erected on the campus of the Centre. Covering of the dome with a rigid cladding consisting of panels of fibre glass reinforced polyester resin has been taken up. The advantage of this type of dome is that it can be assembled at any convenient location and transported by helicopters to inaccessible hilly areas to serve as shelter for troops. The members and joints of the domes can be airdropped in small packages and assembled at site in a few hours.

12.6.3.8 Computerization of methods of analysis and design has been given high priority in the computer centre. Programmes have been developed and widely employed for the analysis of a variety of structures. One such important application that has been made is the rigorous analysis of structures of transmission line towers; these designs are at present either imported or carried out by making wide-off the mark approximations. But this analysis can now be carried out rigorously using the computer programmes developed at the Centre for the analysis of (i) rigid jointed space frames, (ii) rigid jointed plane frames with variable moment of inertia, and (iii) pin jointed plane and space frames. The Centre is now in a position to undertake design of transmission lines of any type, radio or T.V. antennae or any other rigid or pin-jointed plane or space frameworks. Introduction of this design in a 161 km. long transmission line will effect a saving of Rs 6.5 lakhs in respect of cost of the towers.

**12.6.4 RRL Jorhat —** Using available data on earthquakes of the Assam region, interesting observations about the nature of seismicity have been made by constructing a seismic map of the region.

## 12.7 Public Health Engineering

**12.7.1 CPHERI —** MacConkey broth has been found to be superior to lactose broth in conducting presumptive tests for water contamination. It has been found to give less number of false positives. Investigations have however, shown that even for McConkey broth, contrary to general belief, confirmation test is essential when used for raw water analysis.

12.7.1.1 A sanitary survey of the river Jamuna between Delhi and Agra with the object of determining the self purification capacity of the stream has been carried out primarily to a detailed study of the Agra Water Works at the request of U.P. Government. The population equivalent of wastes discharged between Delhi and Agra has been worked out.

12.7.1.2 The quality of raw water near the intake wells of upper lake at Bhopal during the worst period of the year has been assessed by collecting samples from probable sources of pollution and analysing them physio-chemically and examining them bacteriologically. The most important conclusions reached were that (i) the pollution was within permissible limits; (ii) the bacteriological quality of the water in the distribution system was satisfactory; and (iii) that the *p*H of the water was suitable for coagulation of suspended matter with alum.

detected as little as 5 $TCID_{50}$ virus per 100 ml. of artificially polluted drinking waters.

12.7.1.4 Investigations on evaluation of bacteriophages and other microorganisms as possible indicators of virus pollution in naturally and artificially polluted waters and methods of removal of virus pollution have resulted in the isolation of Coliphage from sewage. Experiments were conducted to find the optimum lethal dose of chlorine for inactivation of this Coliphage. Bench scale studies to determine the removal of enteroviruses from drinking water by alum, flocculation and sedimentation revealed that virus removal was comparable with turbidity removal.

12.7.1.5 Experiments were conducted to control water evaporation rate in the Gorewana lake, Nagpur, using cetyl alcohol. The results revealed that evaporation losses could be reduced by 6-16 per cent.

12.7.1.6 Design criteria of water treatment plant evolved at the Institute have been tested both on pilot plant as well as on full scale treatment plants in Andhra Pradesh and found satisfactory. Based on these, type designs are under preparation for water treatment plants ranging from 0.1 to 1.0 million gal. per day (MGD).

12.7.1.7 A sample of polystyrene anion exchange resin developed by NCL was tested for its characteristics such as total anion exchange capacity, basicity and regeneration efficiency. Use of this resin in demineralizing a solution of calcium chloride proved very satisfactory. It has been observed that it can be used for demineralization of water to give low conductivity finished water (0.7 micro-mho) and that its capacity is 15-18 kg./cu. ft.

12.7.1.8 In order to evolve solar still for purifying brackish water, a model (5 ft 6 in. × 6 ft 6 in.) having mild steel evaporating pan (3 ft × 6 ft × 3 ft) covered with glass at inclinations 45° and 30° was tried. It was found that 30° inclination gave good yield.

12.7.1.9 Investigations on designs of containers made from different materials of construction for disinfection of rural well water by carboy method have shown that cement containers (15 in. × 12 in. × 6 in.) and containers with 12 in. diam. and 12 in. height would be satisfactory. The design of chlorine dispenser evolved at the Institute has been found to be satisfactory for disinfection of urban as well as rural wells.

12.7.1.10 A scheme for supplying 0.1 MGD of water from a surface source was prepared for water supply to the bacon factory at Gannawaram. A complete plant (1000-2000 gal./hr) incorporating flash mixer, clarifier, flocculator, sand filter and chlorinator has been designed, fabricated and installed at Poona on River Mulla-Mutha in the premises of Enteric Virus Research Laboratory, Poona.

12.7.1.11 Sewage characteristics in all aspects were under study. As removal of grit in sewage helps sewage processing in several ways, samples of grit were collected at regular intervals from sewage at Nagpur, Delhi and Ahmedabad and analysed for size distribution, specific gravity and volatile matter percentage.

12.7.1.12 The kinetics of variation of BOD with temperature was studied by evaluating BOD of raw sewage at Delhi at different temperatures. It was observed that BOD of sewage was exerted in two stages, the first stage

value for rate constant of variation ($k_T$) at 20°C. was found to be 0.186 ± 0.025. The rate constant $k_T$, which was found to increase with temperature was in better correlation in the form $k_T = aT^b$ where $a$ and $b$ are constants. The BOD values for 5 days for sewage at Bombay were determined at temperatures 20°, 30° and 37°C., and certain correlations were obtained.

12.7.1.13 As design of sewage treatment plants will be facilitated if typical values of per capita BOD (5 days) of sewage at different places are known, attempts were made to determine the values. The values at Ahmedabad (Jamalpur and New Suburban Pumping Station), Calcutta (Batanagar, Gangulibargan and Kalyani) and Jaipur were as follow: 0.056 lb. for Jamalpur and 0.159 lb. for mixed sewage of Jamalpur and New Suburban Pumping Station; Batanagar 0.034 lb. (highest) and Kalyani, 0.018 lb. (lowest); and Jaipur, 0.168 lb. at 37°C. and 0.120 lb. at 20°C.

12.7.1.14 A number of investigations were carried out on industrial waste treatment. The effluents discharged from different unit processes from all paper mills situated on the banks of the River Hooghly and experiments on methods of their treatment by coagulation and sedimentation as well as by activated sludge process were studied. Studies on biodegradability of one of the following organic components (lignin) were also undertaken. The results of activated sludge studies showed that the higher content of the effluents can be reduced to the extent of 71 per cent (maximum) and 36 per cent (minimum).

12.7.1.15 Investigations on grade III wastes from *Orient Paper Mills*, Brajrajnagar, have shown that it would be possible to reduce the BOD by anaerobic digestion and that COD reduction was not quite satisfactory.

12.7.1.16 The most important conclusion that was drawn as a result of characterization and treatment of straw board factory wastes was that it was possible to digest a mixture of straw board sludge and cooker liquor (15 : 1 by volume) at a volatile solids loading as high as 0.113 lb./cu. ft/day in 20 days when supplemented with N and P and produce 14-18 volumes of gas per volume of waste.

12.7.1.17 The following treatment method has been suggested to discharge electroplating waste from *Prestolite Co.* Removal of chromium by treatment at acid *p*H with ferrous sulphate at a rate of 17 parts of ferrous sulphate for one part of chromium; (ii) treatment of cyanide wastes by chlorination under alkaline conditions at a rate of 15 parts of chlorine for one part of cyanide and mixing the wastes with water from cooling system before it is finally discharged.

12.7.1.18 Studies on treatment and disposal of synthetic drug wastes have yielded satisfactory results. Based on the observations, a flow sheet has been worked out for the method of treatment to be adopted by the *Synthetic Drug Project* authorities.

12.7.1.19 Treatment and disposal of liquid wastes from L.T.C. plant was also under investigation. It was observed that the raw liquor from Kothagudem coal and the dephenolated liquor from Ramagundam coal can be treated completely by acclimatized activated sludges provided that they are fed to the sludge after diluting by a factor of 20. It was also observed that, when fed individually, much higher concentrations of phenol, thio-

12.7.1.20 A survey of almost all the tannery wastes in U.P. has been carried out. Laboratory investigations on primary treatment of tannery wastes by plain sedimentation were completed and the results were utilized for design of full scale fill and draw and continuous-flow sedimentation tanks as well as sludge drying beds, and large number of tanneries at Kanpur and other areas in U.P. have installed and been running these plants successfully for about a year.

12.7.1.21 Studies carried out on these full-scale treatment plants showed that (i) about 70-80 per cent of suspended solids were removed and 20-30 per cent of BOD of the tannery effluent were reduced by these devices; (ii) tannery waste sludge (in the Northern part of India) could be dried to 45 per cent moisture content in summer in 4-6 days and in 6-8 days in winter; and (iii) vegetable tannery waste sludge was a better manure than farm yard manure in respect of its nitrogen content and was comparable to wool waste, poultry manure and trickling filter humus. The results of the yield of *jowar* crops grown on the fields using different manures showed that the vegetable tannery waste sludge helped the growth of the crops as good as did poultry manure and even ammonium sulphate. This study indicated that the sludge would have great potentiality as a manure for growing *jowar* and other forage crops.

12.7.1.22 Bench scale continuous studies were also carried out on two systems of biological treatment of tannery wastes. The study indicated that segregation and anaerobic digestion of the spent vegetable tan liquor followed by its mixture with settled beamhouse waste including the neutralized spent chrome tan liquor and treatment under activated sludge process would greatly reduce the requirement of sewage in the waste mixture, the initial BOD load and oxygen consumption. In view of successful completion of this investigation, a pilot plant has been designed and is proposed to be installed in one of the tanneries at Kanpur.

12.7.1.23 A pilot plant to treat about 2,500 gal. of composite waste for the pilot tannery of CLRI has been constructed and is being operated by CLRI.

12.7.1.24 Bioassay studies were carried out on photofilm industry wastes and important conclusions arrived at. Biological treatment of the composite waste (at peak or normal concentrates) of photographic wastes was also carried out. Based on these findings, a flow sheet for the treatment has been prepared and submitted to the Industry.

12.7.1.25 The design of a plant for treating 3500 g.p.h. of acid wastes and 100 g.p.h. of cyanide wastes from the MIG factory of *Hindustan Aeronautics Ltd*, including the pump house, chemical feeding arrangement and sludge drying beds has been completed and submitted to the HAL authorities.

12.7.1.26 Useful observations have been made on treatability of DDT factory effluent by the activated sludge process by working a semi-continuous laboratory scale plant.

12.7.1.27 Alkyl benzene sulphonate (ABS) is a synthetic detergent which finds its way into sewage. It is difficult to degrade it biologically. Hence, investigations were made to study the effect of ABS content on Okhla sewage on germination of brinjal seeds and on growth of lady's finger plants. It has been found that this detergent has a retarding effect on

12.7.1.28 A pilot plant high rate digester of 1,00,000 g.p.d. has been constructed at Hyderabad and its performance is under study.

12.7.1.29 Studies with the laboratory oxidation ditch have been continued with campus sewage enriched with night soil. While using an enriched sewage having BOD of 250-400 mg./litre and using brush speed of 120 r.p.m., the ditch has yielded excellent effluents even at as low a detention time as 12 hr.

12.7.1.30 Oxidation pond studies in respect of performance value of bottom sediments, removal of enteroviruses, hydraulic and organic loading, vegetable farming, fish culture, harvesting of algae have been continued in addition to study of high rate deep stabilization ponds and role of fungi in sewage purification. The reduction of enteroviruses was clearly demonstrated by observing the number of PFU (plaque forming units) reduction.

12.7.1.31 Hydrogen sulphide gas present in sewage sludge gas corrodes gas holders as well as the distribution system. Hence, sewage sludge gas is at present wasted. But if it is possible to remove hydrogen sulphide, the gas can be made use of. Hence experiments were undertaken on Bombay sewage sludge gas to study the removal by gas-scrubbing and by passing through fog-iron ore. It has been found that scrubbing the gas through sewage plant effluent as the scrubbing liquid not only reduces the content of hydrogen sulphide but also that of $CO_2$ thereby enriching the resulting gas in methane and consequently increasing its calorific value. This method has been found to be feasible. In the case of the fog-iron method, it has been found that the efficiency of removal drops down after 20 days of continuous operation.

12.7.1.32 The problem of environmental exposure of mine workers to air borne manganese dust and influence of particle size of manganese on its physiopathological effect have been studied. Data collected in respect of manganese concentration in air in different parts of a ferro-manganese concern near Nagpur at different seasons revealed that the exposure of workers to manganese was more severe in summer than in other seasons on account of high wind velocities and temperatures prevalent in summer.

12.7.1.33 A 600 kg./day pilot composting plant has been set up at the Institute. The data collected so far showed that Nagpur refuse could be composted.

12.7.1.34 Studies have been carried out and large amount of data have been collected with reference to the following types of composting plants erected in different parts of world : (i) Dorr-Oliver's Windrow system, (ii) Bankok system, (iii) Dano system, (iv) Japanese hybrid system developed by INFILCO-EIBARA, and (v) Snell system with masonry aerobic digesters. The results of the studies would be utilized for recommending to the Planning Commission a design of a plant to be completely made indigenously for 20 cities in India with a population of over 3 lakhs.

12.7.1.35 A new design of latrine pan was developed on the basis of the experience of construction and follow-up study of over one thousand latrines at the refugee camps in Maharashtra State. The main features of the new design are : (i) Provision of a shallow and wide water-target to

12.7.1.36 The following compositions/methods have been developed: (i) A water-proof composition with which earthen walls can be fabricated as a near substitute for cement concrete; (ii) a method for fabricating earthen rings to support leaching pits; (iii) an oblique trench as a substitute for alternate pit; and (iv) tools to remove blockage from latrine pans without damaging them.

12.7.1.37 It has been observed that *Ascaris lumbricoides* ova is the most resistant and long lasting ova in the nightsoil compost and that complete elimination of the helminthic ova can be achieved in 2 months and 18 days.

12.7.1.38 Further studies on the cow dung gas plant have led to the following conclusions: (i) Supernatant water can be used for 3-5 months during acute shortage of water with slight reduction in efficiency; (ii) water pressures of 45, 60 and 90 cm. have no effect on dung digestion; and (iii) digesters having 1 : 1 and 1 : 1.5 diameter-depth ratio work efficiently.

12.7.1.39 The following defence oriented projects were undertaken. Three units of pressure filters (capacity, 1000 g.p.h.) have been completed and used. The data collected showed that their average time for filter run varied from 1 to 6 hr with turbidity range 100-30 mg./litre and the corresponding wash water varying from 15 to 4 per cent.

12.7.1.40 The double pot earthenware cartridge using bleaching powder as the disinfectant developed by the Institute has been found to work satisfactorily for 20-30 days in medium sized wells. A chlorine dispenser perfected for use in rural wells is now used widely in Nagpur and Wardha districts with satisfactory results.

12.7.1.41 The comparative efficiency of disinfection of chlorine, iodine and halazone tablets at different *p*H and temperatures on disinfection of bacteria and helminth was taken up for study. The bacterial efficiency of chlorine at *p*H 8 was found to be less than that at *p*H 6. It has also been found that presence of ammonia at 1-2 per cent concentration in water does not interfere with bacterial efficiency of iodine and halazone tablets.

12.7.1.42 Fuel pumps of certain aircraft have been found to be corroded and it has been inferred that this may be due to deterioration of the aviation fuel in storage. Hence, a thorough bacteriological and chemical examination of the fuel has been taken up in collaboration with IIP.

12.7.1.43 The following projects bearing on import substitution have been taken up: Substitution of lead jointing composition used for lead pipes, imported at present, by rubber gaskets; and protein from *Keshari* (*Lathyrus sativus*) in place of peptone for use in bacteriological media. Industrial waste survey of viscose rayon industry and recovery of zinc from the waste using polystyrene ion exchange resin and precipitation techniques were studied. The polystyrene cation exchange resin developed at NCL has been found to be quite satisfactory. The chemical method was also found to be quite good. It consisted in treating the waste with lime to raise its *p*H to 6.0 and separating small quantities of zinc precipitated along with calcium sulphate and then treating the supernatant with caustic soda to raise the *p*H to 9 when almost complete precipitation of zinc as hydroxide

12.7.1.44 Development of equipment needed for air monitoring and industrial hygiene work has been taken up. A constant concentration gas chamber has been fabricated.

## 12.8 Mining

**12.8.1 CMRS —** Roof bolt anchorage tests in seven collieries and investigation on the efficiency of systematic bolting in another colliery have been completed. So far, the tests have been carried out for 13 collieries. The aim of these studies was to assess the suitability of roof bolting in Indian mines. Investigations have been initiated on deveolpment of suitable grips for old haulage ropes for use as roof support and of bamboo bolts to replace steel roof bolts in order to bring about economy and conserve steel.

12.8.1.1 Measurement of strain in the pillar to estimate the optimum width of the pillar in between the gate roads in a colliery was undertaken in order to find out if the width of the pillar can be reduced, thus increasing the percentage of extraction. The results obtained so far indicate that the strain in the pillar decreases away from the inner gate road.

12.8.1.2 Using artificial rock having properties similar to the actual rock encountered in mines, three models of mine strata *in situ* were set up in the laboratory and studied. The models facilitate research on the development of stress and strain, dimensions of mine openings, selection of supports, methods of working, etc. The following are some of the preliminary findings: (i) in massive formation the strain ahead of face travels in a wavy form; (ii) the zone of maximum strain corresponding to abutment lies at about 5 m. ahead of face; and (iii) the strain value in this zone increases with the increase in size of excavation. Up till now, five equivalent material models have been set up and studied.

12.8.1.3 Underground excavations in mines often give rise to surface movement causing damage to the property lying over mining areas. Laboratory investigation into various aspects of mine subsidence has been undertaken; this may lead to proper planning of the method of mining by judicious superimposition of tensile and compressive strain caused by two underground workings, either in the same seam or in two different seams. Preliminary investigation has revealed that the movements are more regular in longwall workings than in board and pillar workings.

12.8.1.4 In the areas where procuring sand becomes difficult and low depth and gradient of the mines make hydraulic stowing a difficult proposition, pneumatic stowing is taken recourse to. Pneumatic stowing at a colliery of the National Coal Development Corporation for establishing the feasibility of this method has given very encouraging results.

12.8.1.5 Operational research on reorganization of transport at a colliery was completed. The time-study data made available during the project work have helped to improve efficiency of operations and to achieve the target of production.

12.8.1.6 Investigations on the assessment of fine dust in mines to evaluate the health hazard due to exposure to such dust has been continued. Preliminary results of the study on the effect of water spraying on the sup-

12.8.1.7 A method has been standardized to determine the diffusing capacity of the lungs. So far, this method has been utilized for assessment of lung function of pneumoconiotic workers in three mines.

12.8.1.8 Preventive and minimization of coal dust explosion in mines by stone dusts has been believed to be related to the dispersibility of stone dusts. The physical changes undergone by stone dust under high humid condition have not been fully studied so far. A marked variation in the impairment of dispersibility for different dusts by absorption of moisture has been observed. Inflammability tests carried out after keeping the stone coal dust mixtures at different humidities for different time period proved beyond doubt that the dispersibility may not be the particular property of the inert dust that might prevent or minimize coal dust explosion hazard in high humid underground mine.

12.8.1.9 The development of detector tubes for hydrogen sulphide is almost complete and a draft application for obtaining a patent has been prepared.

12.8.1.10 Work on gas emission coal seams and on the development of detector tubes for hydrogen sulphide was continued. A bench model methanometer has been developed. It indicates the presence of gas within 5 sec. The accuracy of the instrument is 0.02 per cent in the range of 0-1 per cent and 0.1 per cent in the range of 0-5 per cent. A scheme for fabricating this equipment on a pilot scale has been taken up and is likely to be implemented shortly. The scheme is having a good response from the industry.

12.8.1.11 Determination of geothermic gradient in various coalfields was continued as it would be useful in evaluating ventilation requirements of a new mine or a developing mine. At the request of the National Coal Development Corporation, temperatures were recorded at the bottom of completed boreholes and in running boreholes in Parbatpur, Putki (Central Jharia) and Mahal fields.

12.8.1.12 Forty-seven anemometers and five velometers received from collieries were calibrated.

12.8.1.13 For improving ventilation standard, following requests from mine managements, complete ventilation survey was undertaken in four mines and pressure losses in shafts were determined in two mines. Ventilation surveys so far have been undertaken in thirty mines.

12.8.1.14 Following a reference from Government department, investigation was initiated to find out the suitability of Indian made electric-resistance welded conduit for use in flameproof installations in lieu of solid-drawn steel conduits.

12.8.1.15 Until a few years ago instantaneous electric detonators were not required to be tested for safety in fire-damp. Recent trends in shot-firing (specially sequence firing using delay detonators) have necessitated verification of the safety in gas of detonators also. To meet urgent requirements, a 1 cu. ft cubicle was made available and is being employed for tests on instantaneous electric detonators. Efforts to see if time taken for the tests could be reduced by adoption of a multicompartmented vessel (as is used for testing delay detonators) showed that, though there was a little fired singly in gas under a free suspension condition is being tentatively retained for instantaneous detonators.

12.8.1.16 An investigation to study the effect of ageing on (i) velocity of detonation, (ii) continuity of detonation, (iii) Ardeer double cartridge, (iv) strength of certain permitted explosive compositions has been taken up. The studies made so far with the explosives have shown that these properties deteriorate much more rapidly than expected. The findings were brought to the attention of the Chief Inspector of Explosives.

12.8.1.17 Investigation of thermal energy liberated at electrical sparks is continuing. Preliminary results have shown that it may be feasible to measure the energy in thermal terms.

12.8.1.18 A comparative study of test procedures for flame test as per Indian Draft Standard (which is based on the NCB and British Standards specification) and as per the recommendations of the International Standards Organization (ISO) was made on behalf of the Indian Standards Institution. Fourteen samples of conveyor belting, both foreign and Indian, were investigated. It was found that the test as per Indian Draft Standard was more severe than that recommended by ISO. Hence it was recommended that the method as per Indian Draft Standard be retained.

12.8.1.19 Studies were continued, on the various properties of wire ropes used in mines, with a view to standardize a comprehensive test procedure for wire ropes.

12.8.1.20 Timber props made commonly from Sal species are extensively used in Indian mines as roof support. As Sal is in heavy demand, a study of the strength of wooden props with other inter-related physical and geometric variables was continued. It was observed that four species—Karam, Kendh, Dhaw and Asson—may also be used as roof support in place of Sal.

12.8.1.21 Investigations were initiated on (i) the cause of frequent failure of draw bas in coal mines, and (ii) the life of drill bits used in coal seams having different physical and chemical properties.

12.8.1.22 Investigations have been undertaken on the following projects: cheap method of filling up of voids created after metal extraction in a mine, operational research on mine pumping, cause of frequent failure of draw bars in coal mines, life of drill bits used in coal seams having different physical and chemical properties.

12.8.1.23 Facilities for destructive and proof load testing and non-destructive testing of equipment used in mines continued to be provided to the industry.

12.8.1.24 Investigation and testing work has been carried out on apparatus for use in certain atmospheres of gases and vapours of hazardous nature, like flamed-proof electrical equipment (Indian and foreign), temperature rise classification of flame proof light fittings, dust-tight/dust-proof fittings, lighting fittings and lamp fittings. Explosive compositions — Group $P_1$ and Group $P_3$ — and exploders for performance and safety in methane-air mixtures were investigated and tested. Indian made multi-shot exploder for service in non-gassy mines, indigenous batteries required for these

## 12.9 Aeronautical Engineering

**12.9.1 NAL —** The Laboratory was reorganized in six functional divisions: Aerodynamics, Structural Sciences, Material Sciences, Propulsion, Systems Engineering and Mathematical Sciences. A basis was established for project-oriented, cost accounted research work, and investigations on 80 projects were undertaken.

12.9.1.1 The 4-ft trisonic tunnel was in the final stage of assembly; the settling chamber, supersonic nozzle, model cart, variable diffuser have been erected. The design of a concrete sub-sonic diffuser was completed. The 1-ft trisonic tunnel was commissioned and a number of trial blowdown tests were conducted for establishing pressure control system setting under different conditions of tunnel mass flow, and for nozzle flow calibration. The flow uniformity measured in the supersonic test section using 1.8 Mach nozzle blocks was found satisfactory. A slotted-wall test-section for transonic testing was installed and is under calibration.

12.9.1.2 Mach 2.5 and 3.5 nozzle blocks were designed and constructed. Schlieren optical glass windows for the test section were completed and the Schlieren system was commissioned. Several test models and a series of aerodynamic balances were designed and are under construction.

12.9.1.3 A low turbulence tunnel with two test sections of 15 in. × 12 in. and the other 5 in. × 12 in. was being set up. The design of a fan and wide angle diffuser was completed for this tunnel.

12.9.1.4 Aerodynamic investigation of 'Air intakes' was taken up. Air-intake models for the study of spillage-drag and experimental set-up for basic shock stability investigations were designed and fabricated.

12.9.1.5 Theoretical and experimental investigations on dynamic stability and axisymmetric bodies at transonic and supersonic speeds were taken up. To fabricate wind tunnel test models of two-dimensional and three-dimensional wings, a generalized computer programme was developed to provide the machine setting using the tangent-milling method of fabrication. The construction of trial model was taken up.

12.9.1.6 The following equipment were designed and fabricated in the Laboratory: (i) 5-ton capacity sub-resonant fatigue testing machine; (ii) 300-in. lb. cantilever fatigue testing machine; (iii) 10-ton capacity sub-resonant fatigue testing machine; and (iv) an experimental filament winding machine to fabricate filament-wound high performance structural components such as rocket motor casings and missile shell structures.

12.9.1.7 A 1/10 scale low speed flutter model, representing a typical trainer aircraft was completed. Investigation on gust-response of a typical jet trainer was completed.

12.9.1.8 Natural frequencies of a few sandwich beams were calculated for free-free, fixed-fixed and fixed-free conditions. Experimental verification of the results was made for certain sandwich beams for free-free condition.

12.9.1.9 Problems on crack propagation, photoelasticity stress concentrations in shells, Moire fringe techniques and Matrix methods were taken up for investigation.

12.9.1.10 The fabrication of Ejector Test Rig was nearing completion.

12.9.1.11 In order to provide high temperature source for studies arc jet facility was designed and fabricated. A set of design charts for the design of arc heater operating with nitrogen gas in the inlet flow regime was developed. Theoretical studies on the effect of heat transfer on the performance of a rocket nozzle were completed.

12.9.1.12 A test rig for calibration of flat plate orifice was installed and some orifice plates were calibrated. The design of a propulsion wind tunnel was taken up. Studies were undertaken on the use of air to air ejector as exhaust in this tunnel.

12.9.1.13 Studies were undertaken for the design of a spectrograph, two-dimensional subsonic cascade tunnel, determination of burning rate of solid propellants and on ducted faces.

12.9.1.14 Processes for the following instrumentation systems were developed: (i) Linear variable differential transformer type pressure transducer (range 0-50 psig.); (ii) capacitance type pressure transducer; (iii) variable reluctance type pressure transducer; (iv) two types of displacement transducer (displacement range; type TD10, ± 0.01 in. max., type TD50, ±0.050 in. max.); (v) ring dynamometer type load cell; (vi) thermocouple amplifier; (vii) transistorized amplifier for pressure and displacement transducers; (viii) single and ten-channel strain indicators; (ix) ten-channel load indicator; (x) electromagnetic type vibration pickup; and (xi) 2 in-Mach-zender interferometer for flow visualization studies.

12.9.1.15 The integrated control system for the 1ft × 1 ft blowdown wind tunnel was designed, fabricated and installed. In particular, the work involved was the commissioning of a pressure regulating valve control system to an accuracy of ± ½ per cent up to 100 p.s.i. A multichannel pressure scanning system was fabricated and used for the calibration of the 1 ft wind tunnel test section pressure distribution.

12.9.1.16 A complete 10-channel data handling system was developed. The following components used in data handling system were developed: digitizers, translators, digital display units. The design of a digital voltmeter using indigenous semiconductor devices and a transistorized d.c. amplifier was completed.

12.9.1.17 A Rheoelectrical Analogy deep tank (5-ft × 5-ft × 4-ft) made of granite was set up along with accessories for studies on potential flow. Some theoretical investigations were completed on hypersonic flows, synchronous equatorial earth satellites and on magneto-hydrodynamics. Number of programmes were developed for SIRIUS digital computer.

## 12.10 Medical Science, Drugs and Pharmaceuticals

**12.10.1 IIEM —** Phage-typing studies of vibrio strains isolated in cholera epidemic in various states in India had indicated that cholera El Tor rapidly eliminated classical cholerae. One explanation of this phenomenon has been found in the laboratory studies that in mixed cultures El Tor vibrios rapidly eliminate classical cholera vibrios. The precise mechanism of this interaction has been elucidated by the finding that the two types of vibrios differ in their sensitivity to the action of hydrogen peroxide and that El Tor vibrios produce hydrogen peroxide during their growth in concentration lethal to classical cholera vibrios.

vibrios has proved promising. The strain has been found to be stably apathogenic and this has been confirmed by independent groups of workers in USA and Japan. Administration of the vaccine strain in single dose has been found to protect animals against subsequent challenge with classical cholera vibrios or El Tor vibrio strains from patients. It has also been found that the strains are capable of multiplying and getting established in the intestinal tract, an essential requirement for the vaccine being effective. Immunological studies have proved that after oral administration of the vaccine, protective anti-bodies are present freely in the intestinal tract as well as in the cells of the mucous membrane of the intestine. These observations prove that the live oral vaccine is likely to be effective against human cholera infection.

12.10.1.2 Further work on the inhibitory effect of erythrose on the growth of *Vibrio cholerae* observed earlier has been continued. It has been observed that (i) whereas erythrose inhibits oxygen consumption of resting cells of *V. cholerae* with glucose as a substrate, there is no such inhibition with cell-free extracts under the same condition; and (ii) uptake of $^{14}$C-glucose $^{32}$Pi and $^{14}$C-methyl glucoside by resting cells are insignificantly inhibited in presence of erythrose. These observations suggest that the growth inhibitory effect of erythrose is primarily due to its action on the glucopermease activity of this organism.

12.10.1.3 Investigations on the use of one of the indigenous plants *Casseria esculanta* (Saptarangi) for producing model diseases in experimental animals showed that the crude extract of the plant produced hypoglycemic effect in animals. However, one of the fractions from the total extract, leucoanthocyanidine, was found to raise blood sugar by about 45 per cent from normal one, the effect starting one hour after oral administration reaching its maximum in 8 hr, and lasting up to 20-24 hr. It is expected that this constituent obtained from an indigenous plant can find use for producing experimental hypoglycemic conditions in animals.

12.10.1.4 Study of the effect of Jatamansone at the rate of 40-60 mg./day on hyperkinetic children and on monkeys with hyperkinesia produced by surgical frontal lobotomy has shown marked improvement in the clinical picture. The maximum effect has been obtained after 20-23 days of treatment. As little is known about the neuropathology of hyperkinesia, study of its mechanism using this drug was taken up. It has been observed that Jatamansone just like hydroxylamine raises the γ-aminobutyric acid level in rat brain and causes sedation and fall in susceptibility to electrically induced convulsions. It is conjectured that Jatamansone might raise γ-aminobutyric acid level by the formation of α-glutamic acid (beneficial in mental deficiency) via α-glutamic acid decarboxylase.

12.10.1.5 Studies on pathophysiology of atherosclerosis in Indian pigs (*Sus-scrofa*) have been undertaken as they are physiologically much alike human beings. Experimental atherosclerosis was produced in pigs of 6-8 months by feeding them with high lipid diet for 2.5-3 months. The following observations have been made: (1) development of spontaneous atherosclerosis at the age of 2.5-3 years followed by its increase at 1.5-6 years; (ii) increase in cholesterol low density lipo-protein triglyceride and magnesium in blood in advancing age with no change in blood sugar level; (iii) decrease of blood coagulation time and increase of *E.S.R.* and platelet clumping time at first and then remaining constant.

infarction has been suggested. Increased plasma amines in patients with myocardial infarction has been shown but their levels in the heart tissue under such circumstances remain disputed.

12.10.1.7 Studies in the Institute showed the alarming increase in the urinary excretion of norepinephrine in the patients of myocardial infarction. The cardiac amine levels decreased in the infarction area as compared to the normal tissue. Nialamide which raised the catecholamine levels in the heart, reverted back the ventricular arrhythmia, associated with coronary artery ligation, 24 hr after the administration.

12.10.1.8 Structural similarity between nialamide and noradrenaline has been suggested as an explanation of the mode of antiarrhythmic action of nialamide. The infrared spectra of nialamide indicates the molecule to be capable of forming hydrogen bonds and association with suitable surfaces. It has been concluded that possibly nialamide or a metabolite of it competes with nonepinephrine and thereby renders it incapable of stimulating the receptor to produce arrhythmia.

12.10.1.9 Effect of Jawaharene, an antibiotic isolated at the Institute, on metabolism of human malignant tissues (e. g. cancer of uterine cervix) was studied with the help of labelled isotopes like glucose, leucine and acetate. After 2 hr incubation of homogenate of malignant tissue with labelled material with ATP and Mg ions with and without Jawaharene and Mitomycin, it was observed that tumour tissue showed 3 to 5 times higher turnover of proteins and lipids than normal; Jawaharene caused 30-50 per cent inhibition of the metabolism of tumour tissues in 2 hr. Effect of this antibiotic and transplanted tumours in mice, e. g. Schwartz lymphosarcoma with the above-mentioned technique was found to be less pronounced. Chemotherapeutic studies on the effect of daily doses of Jawaharene (100 mg./kg. and 150 mg./kg.)in mice with transplanted solid tumour (Schwartz) have shown low grade protection (25-30%). Animals withstood the doses of Jawaharene without loss of weight and agility. Chemical fractionation of Jawaharene by column chromatography resulted in 7 fractions. Attempts are now being made to prepare these fractions in sufficient quantities for chemotherapeutic examination.

12.10.1.10 The effect of glucose feeding to mice on tumour uptake *in vivo* has been tried by subcutaneously injecting them with mouse fibrosarcoma (MFS). It was found that whereas animals not fed glucose got tumours without any glutamine on the surrounding tissues, the reverse was the case with animals fed with glucose.

12.10.1.11 It has been shown indirectly by using electron acceptors like pyruvate and cysteine that lactic dehydrogenase in tumour tissues is TPNH-dependent and not DPNH-dependent. This has been found to be the case for other organs such as spleen.

12.10.1.12 Some of the physico-chemical properties of the antigen properdin isolated at CDRI have been studied. A purified form of properdin having 1.1 μg. of nitrogen per unit of biologically active preparation giving a fine single line of precipitation by agar gel double diffusion and gel electrophoresis techniques has been obtained. It has also been found that properdin of this purity obtained from different species of animals has specific antigenic character depending on the species.

diiodotyrosine from monoiodotyrosine and inorganic iodide. The enzyme needs the presence of hydrogen peroxide, or hydrogen peroxide generating system for its activity. Antithyroid drugs like iodoacetate and *p*-chloromercuribenzoate inhibit the enzyme.

12.10.1.14 Observation on the gametokinetic response of human chorionic gonadotropin (HCG) in toad (*Bufo melanostictus*) has shown that spermiation of the toad is neither mediated through adrenal gland by activation and adrenaline release as in *Rana pipieus* and *Xenopus laevis* nor by stimulation of the pituitary by HCG.

12.10.1.15 It has been reported earlier that the presence of SH group in human chorionic gonadotropin (HCG) is responsible for its biological activities contrary to hitherto held belief. Further supporting evidences have now been secured to show that this function is contained in the interstitial cell stimulating hormone (ICSH) factor of both HCG and pregnant mare's serum gonadotropin.

12.10.1.16 The stem-bark alkaloid AL 60 of *Alangium lamarckii* has been found to be a mixture of at least three components. The individual alkaloids have been separated. Three more minor alkaloids from the root-bark and a number of bases including ankorine, m.p. 175°, $[\alpha]_D$—60 ($CHCl_3$) has been isolated from the leaves.

12.10.1.17 Relating biochemical findings obtained with gross samples of brain tissue to cerebral function is difficult on account of cellular heterogeneity of brain tissue. Hence, separation of neurones and glia cells in biochemically active form for experimental work has become necessary. Micro-dissection methods which have been found satisfactory for this purpose do not yield sufficient quantity for biochemical studies in the macro scale. Consequently, investigations were undertaken on development of methods for separation of neurones and glia in milligram quantities. Experimental conditions have been worked out for this separation, consisting in brief exposure to trypsin with vigorous agitation and dispersion by hand and density gradient centrifugation.

12.10.1.18 A new type of adenosine triphosphate has been detected in intestinal tissue. This may be of significance in relation to processes of active transport. It has been separated by irrigation of the lower two-thirds of the small intestine with isotonic saline. Unlike other ATPases described so far, the enzyme does not require magnesium or calcium for its activity, but is non-specifically activated by the alkali metal ions in concentrations of 100-150 mm. The enzyme appears to be metalloprotein containing zinc and exhibiting multiple phosphohydrolase activity, possessing also alkaline phosphatase and pyrophosphatase activities. The proportion of these three phosphohydrolase activities remained unchanged on fractionation with ammonium sulphate, by adsorption on DEAE cellulose and selective elution, and exposure to 55°C. for 15 min. The thermal treatment increased the level of all three activities. The enzyme is insensitive to sulphhydryl reagents but is strongly inhibited by reducing agents which may act on the disulphide group. The enzyme has been shown to be located in the brush border and further attempts at purification are in progress starting with a preparation of brush border particles.

12.10.1.19 Interesting results have been obtained by metal hydride reduction of 4-quinazolones and acid-induced rearrangement of arborinol and isoarborinol, the new tri-terpenes from *Glycosmis*

occurrence of two $C_3$ epimers and the corresponding ketone in the same plant is of considerable biogenetic significance.

12.10.1.20 Presence of glycolytic pathway in protozoa has not been shown so far very conclusively. It has been observed that cell-free extracts of *Leishmania donovani* catalyses the production of lactic acid from glucose under anaerobic condition. With the help of 2 : 4-dinitrophenylhydrazine as a trapping agent and paper chromatography, pyruvate formation has been shown conclusively. Further, presence of almost all the enzymes of glycolysis have been shown in cell-free extracts. Utilization of other sugars, e.g. galactose and mannose, have also been noted with both intact and cell-free extract of this organism.

12.10.1.21 In an attempt to find out the factors which control the conjugation of bile acids in different species, a method has been standardized for the separation of free and conjugated bile acids, by thin layer chromatography on silica gel pletes using acetic acid, isoamylacetate, *n*-propanol and water (15 : 20 : 10 : 5).

12.10.1.22 Studies on selection of suitable endogenous interferon inducing agents from various polysaccharides which might be effective in viral infection have been taken up. Stock virus preparations to be used for this purpose have been prepared and interferon assays *in vitro* in tissue culture and *in vivo* in mice have been standardized.

12.10.1.23 Gelatin fibres suitable for optical work have been developed and used in Klett Summerson Colorimeter. They possess very good half band width and transmission factor at different peak values between 400 mμ and 70 mμ. The filters have given comparable results with imported ones. They are unaffected at temperatures of 60°/70°. They are also unaffected by fungus even after keeping for 18 months and by immersion in water for a few hours. The cost of filters (2 in. × 2 in.) is only Rs 2.00 as compared to the current price of imported fibre of Rs 80/90.

**12.10.2 CDRI** — A large number of compounds were biologically evaluated as post-coital oral contraceptives. Encouraging results have been obtained with four compounds in animal experiments.

12.10.2.1 Long-term studies (546 days after insertion) on the effect of the 'loop' on the physiology and biochemistry of the uterus have not revealed any untoward changes.

12.10.2.2 A method for producing cent per cent hepatic amoebiasis in hamsters has been developed. This technique can be used for the screening of drugs in systemic amoebiasis. It has been found that bacterial extract of glutamic acid does not cause excystment of amoeba cysts in the presence of emetine, but removal of emetine readily induces excystment. An axenic culture medium for the mass cultivation of amoebae has been developed. It would be of value for the enzyme and immunological studies of amoebae.

12.10.2.3 Strains of *Hartmanella* spp. have been reported recently to cause meningoencephalitis in man. Similar strains causing fatal infection in mice have been isolated from Lucknow soils. Vaccinia virus (Bangalore strain, a subline of IHD strain) has been adapted to produce haemagglutinins in chick chorioallantoic tissue culture. This method has been used to test anti-viral activity. Mouse foetal embryonic tissue cells have been successful-

12.10.2.4 The aetiology and pathogenesis of atherosclerosis have been taken up for study. In a study of the role of the dietary factor, choline, it has been observed that albino rats maintained on a low-protein diet with choline supplement showed evidence of coronary heart disease. A method has been developed for the production of experimental atherosclerosis in rabbits. Chronic lesions are produced in 4 months. The incidence of mortality in the animals has been found to be low.

12.10.2.5 It has been found that photochromogenic mycobacteria of Runyon's Group I (strain Trudeau 3 and 4) are superior to BCG (used in the prophylaxis of tuberculosis and leprosy) in experimental murine leprosy.

12.10.2.6 Transaminases which mediate the synthesis of amino acids have been extensively purified from mammalian red blood cells. An enzyme which degrades lecithins formed in germinating gram has been obtained. A metallic cationic complex has been prepared which is an activator of diastase while a simple polyanion has been found to inhibit RNAse activity. A cell free protein synthesizing system has been prepared from germinating gram which incorporates amino acids into proteins. An amino transferase, mediating transfer of the amino group from alanine to 2-oxoglutarate, has been purified extensively from equine RBC and found to consist of three isomeric forms on paper and starch gel electrophoresis.

12.10.2.7 Recent field trials have shown the limitations of present day cholera vaccines. With the object of developing a live culture vaccine which could be orally administered, attenuated strains of *V. cholerae* have been prepared with the aid of a chemical mutagen N-methyl-N′-nitro-N-nitroso-guanidine. These mutants do not give rise to any pathological effects in experimental animals and do not show any evidence of residual virulence.

## 12.11 Botany

**12.11.1 NBG —** Studies on the evolution of new and better varieties of *Portulaca*, *Rosa*, *Chrysanthemum*, *Canna* and *Acidanthera* by inducing mutations by irradiation with gamma rays have been continued.

12.11.1.1 Various clones of induced mutants of perennial *Portulaca* have been isolated and multiplied. Single flowered mutant clones have been successfully hybridized, using pollen of different varieties of double flowered annual *Portulaca*, in an effort to produce strains of double flowered perennial *Portulaca* with different colours. Somatic mutations in the colour and shape of flower have been detected after irradiation and bud-wood of the rose varieties Montezuma, Suzon Lothe, Super Star and Crimson Glory. Buds of mutant Montezuma and Crimson Glory have been budded on Edward Rose stock to multiply the mutants for establishing new varieties.

12.11.1.2 Suckers of ten varieties of *Chrysanthemum* were irradiated and flowers on the plants raised from the irradiated suckers of the variety Madford are showing different petal colours. Similarly, plants raised from the irradiated corms of *Acidanthera* have been found to exhibit somatic changes in size, shape and colour of the flower. Suckers from the irradiated plants of *Canna* variety Soldier Boy, showing changes in size, shape and colour of the petals, have been isolated.

12.11.1.3 Better rooting and growth and greater survival, with the

12.11.1.4 A large number of hybrids, between various varieties of tomato (*Solanum esculentum*) and brinjal (*S. melongena*) have been produced with a view to exploit heterosis in these species for commercial purposes.

12.11.1.5 Cytogenetical studies have been continued on *Gloriosa superba*, an ornamental plant, which yields colchicine, a highly useful product which is being imported at present, hybrid *Petunia* and *Antirrhinum*, the seeds of which are imported, *Canna*, another ornamental plant and a substitute source of arrowroot starch and *Amaranthus*, a source of highly proteinaceous food and also an ornamental plant. Germ-plasm of all these plants has been built-up. Male sterile lines have also been isolated. Superior hybrids of *Gloriosa*, *Verbena* and *Amaranthus* have been obtained.

12.11.1.6 With the help of tissue culture technique, embryoids and plantlets have been induced in the leaf-callus tissue of *Rauvolfia serpentina*. The plantlets thus obtained have been raised into healthy individual plants and transferred from test tubes to soil. This new method of clonal propagation has many advantages over the conventional method of vegetative propagation from cuttings. Mango and citrus plants have also been obtained from their leaf-callus tissues, by this method.

12.11.1.7 Pharmacobotanical studies are being made on a number of Indian medicinal plants, *Eclipta alba* (*bhangra*), *Boerhaavia diffusa* (*punarnava*), *Abrus precatorius*, *Cassia* spp., *Alangium salvifolium* (*ankola*), *Barringtonia acutangula* (*samudraphala*) and *Abutilon hirtum* (*kangi*).

12.11.1.8 In efforts to find suitable substitute for the imported galangal rhizome, two species, *Alpinia calcarata* and *A. speciosa* have yielded good quality oil and appear to be suitable in this respect.

12.11.1.9 With a view to ensure proper identification and classification of seeds, investigations on the structure and histochemistry of seeds of a number of economically important families, viz. Amaranthaceae, Apocynaceae, Asclepiadaceae, Compositae, Convolvulaceae, Euphorbiaceae, Labiateae, Leguminoseae, Malvaceae, Scrophulariaceae and Solanaceae, have been carried out. These investigations will be useful in detecting impurities in and checking adulteration of foodstuffs and indigenous drugs and will lead to new sources of edible and nonedible oils and fats for commercial exploitation.

12.11.1.10 A systematic survey of virus diseases, adversely affecting the flowering and quality of blooms of ornamental plants, particularly *Zinnia*, *Chrysanthemum* and *Hibiscus* at NBG has been taken up.

12.11.1.11 Seventy-five new varieties of *Chrysanthemum* have been introduced and all the 350 known varieties of this ornamental plant have been classified, according to bloom types, into three main classes. These have also been distributed into three main groups—early, medium and late flowering ones.

12.11.1.12 Better and healthier blooms of large-flowered chrysanthemums have been obtained at a lesser cost by propagation through cuttings made in June, instead of the usual method of propagation by suckers planted in February, followed by potting.

12.11.1.13 Studies on the hastening of seed germination by chemical methods, determination of suitable time and intensity of pruning and

12.11.1.14 Introduction trials and chemical evaluation of a number of alkaloid-bearing plants, viz. *Matricaria chamomila* and *M. inodora*, *Mentha piperita*, *M. arvensis* and *M. aquatica*, *Rauvolfia serpentina*, *Glycyrrhiza glabra*, *Plantago ovata*, and *Hyoscyamus* and *Solanum* spp. have been attempted. About ten foreign species of *Solanum* appear to grow well at Lucknow. Some of *R. serpentina* seedlings treated with colchicine, have shown characteristic changes like thicker and greener leaves, shorter first pair of leaves with wavy margins, etc. A temperature of 13°C. appears to be the most suitable temperature for the germination of *P. ovata* seeds.

12.11.1.15 Morphological and taxonomic studies on *Elatostema* spp., *Grewia* spp., *Paspalum distichum* & *P. punctatum*, *Phragmites karka* & *P. maxima*, *Echinochloa colone*, *Nepeta* sp., *Ageratum* sp., *Phyllanthus* sp., *Andrachne* sp., and *Clematis* sp. have been made, yielding new information on the nomenclature, geographical distribution and taxonomic affinities and limitations of various taxa, particularly *Grewia* and *Elatostema*. A new species, *Nepeta togarhensis* Sharma, sp., nov. (Labiateae) has been established and a new record of the species *Kohautia nagporensis* from the upper Gangetic plain has been made. Data on the poisonous and succulent plants of the country have also been collected.

12.11.1.16 Pollen morphological studies on several families belonging to the orders Monochlamydeae and Thalamiflorea indicate evolution in the dicotyledons to have proceeded along two lines—the 'Magnolian stock', represented by unicolpate pollen grains and the 'Ranalian stock', represented by predominantly tricolpate pollen grains.

12.11.1.17 Morphological and taxonomic studies on 12 genera, viz. *Achrostichum*, *Arthropteris*, *Blechnum*, *Doodia*, *Histiopteris*, *Hypolepis*, *Lomagramma*, *Oleandra*, *Schizoloma stechnocleana*, *Tectaria* and *Woodwardia* have been carried out and phylogeny of each genus studied. Stelar organization of the rhizome in the family Polypodiaceae has been studied. Structure and development of *Dennstacitia*, *Dicksonia*, *Dryopteris*, *Davallia*, *Fadyenia*, *Hypoidematium* and *Leucostegia* have been studied and their phylogenetic value assessed.

12.11.1.18 Taxonomic studies on the other four families, viz. Marattiaceae, Ophioglossaceae, Osmundaceae and Schizaeaceae, have been continued. Spore studies of nearly 1,000 species of ferns have been completed.

12.11.1.19 Taxonomic studies on India Agaricales have been continued and twenty-five species have been identified. Five species—*Marasmius siccus*, *Pluteus carvinus*, *Agaricus odmani* and *Hohenbuehalia peteloides*—have been reported for the first time from India.

12.11.1.20 Two new genera of liverworts, viz. *Saccogyna* and *Colura*, have been reported from India for the first time and two species of each have been identified. One of the species, *Colura tenuicornis* has been found to be epiphytic, instead of epiphyllous as reported in the literature.

12.11.1.21 As a part of taxonomic studies on India diatoms, 45 species have been identified from a collection made from Kashmir. Among these, 12 species have been reported for the first time from India. A new variety of diatom, *Cymbella cistula* var. *rostrata*, has been discovered.

**12.11.2 RRL Jammu —** A new disease causing wilt, damaging

12.11.2.1 Out of the six fungicides tested to control the powdery mildew of Japanese mint *Mentha arvensis* under the field conditions, Hexasul and Karathane W. D. were found to give promising results.

12.11.2.2 Two strains of ergot fungus, *Claviceps purpurea* (Fr.) Tul. R-55 and R-56 have been found to be suitable for large scale cultivation as the sclerotia produced by these two strains contained ergotamine alkaloid 0.14 and 0.27 per cent respectively. R-57, another strain tested in a limited scale, has been proved to be a promising strain for the production of ergometrine. Extensive trials on large scale of these three strains (R-55, 56 & 57) are in progress.

12.11.2.3 Out of the twenty different viruses collected from different medicinal and aromatic plants viruses causing mosaic in *Solanum aviculare*, *Digitalis lanata* and *Tylophora indica* have been studied thoroughly.

12.11.2.4 Techinques of cultivation of two edible mushrooms *Agaricus bisporus* (Common European Mushroom) and *Volvariella* sp. (Paddy straw mushroom) have been perfected on a laboratory scale.

12.11.2.5 Local edible mushroom, Dhingri (*Pleurotus* sp.) was brought into culture and cultivated artificially on a laboratory scale. This mushroom is an important article of commerce in the region.

**12.11.3 CSMCRI —** Survey of drift seaweed at five centres all over the Indian coast has revealed that *Sargassum* forms the major component of the drift while *Gracilaria* is frequent. Studies on the growth and phenology of *Ulva fasciata*, *Gracilaria millardettii* and *Hypnea musciformis* at Veraval and *Sargassum swartzii* and *Cystophyllum* at port Okha and on growth promoting substances and nutritional requirements of seaweeds have been made. Attempts to mass culture apical fragments of *Gracilaria millardettii* have been undertaken. Morphological studies have been done on *Ulva*, *Enteromorpha*, *Sargassum swartzii*, *Cystophyllum*, *Hormophysa triquetra*, *Gracillaria millardettii* and *Hypnea musciformis*.

## 12.12 Agriculture

**12.12.1 NBG —** Investigations are in progress on diagnosing fertilizer needs of grape vines by foliar analysis, increasing fruit yield by shoot-tip removal and fertilizer application and increasing the sugar content of grapes with the help of growth regulators and fertilizers. A number of new varieties have been introduced for studying their suitability for juice, wine and raisin manufacture. Studies have also been carried out on the propagation of grape-vines from seeds, cuttings and grafts. Many hybrids have been produced with the object of breeding grape varieties possessing earliness (of ripening), seedlessness and high TSS. Hybrid seeds have been sown for raising the crop.

12.12.1.1 Cultivation trials of *Agaricus bisporus*, an edible mushroom, and at present an imported commodity, are being made with horse-dung and wheat-barn composts under local conditions.

12.12.1.2 Cultivation trials have also been made with another edible mushroom, *Macrolepiota rachodes*, occurring wild around Lucknow. Pure

12.12.1.3 Work on the control and eradication of angiospermous parasites of a number of well-known fruit and timber trees has been continued. Certain new parasiticidal sprays have been tested and observations recorded.

**12.12.2 CSMCRI —** Pot culture experiments under sea water irrigation with wheat (var. Karchia and Kata) and *bajra* (var. Babapuri) have been carried out.

12.12.2.1 Experiments on *bajra* and groundnut using seaweed as manure have shown that seaweed manure is superior to farmyard manure in case of *bajra* while in case of groundnut the response is as good as is the case with farmyard manure.

12.12.2.2 Fertilizer trials on groundnut in the Institute's farm have shown that potassium schoenite gives 15-20 per cent higher yield over control, 8-10 per cent higher over potassium chloride and almost similar to potassium sulphate applications. Potassium schoenite has been supplied to about 20 agricultural research stations for trials.

**12.12.3 CFRI —** Nitrified samples from rich garden soil of CFRI were estimated for percentages of organic carbon, nitrate-nitrogen, ammonia-nitrogen and soil *p*H.

12.12.3.1 Toxicity possibly produced by coal fertilizer to the soil, which possibly resulted in yellowing of leaves and stunted growth of plants, was explored by studying pot-growth of maize plants. Where the fertilizer was applied two weeks before the sowing of seeds, normal colour and growth could be seen. Bacteriological analysis of the soils from trial fields at Sitagarha Farm, Hazaribagh and CFRI was carried out and total bacterial counts were determined.

12.12.3.2 Since coal fertilizer is a slow acting one, urea, phosphorus and potassium were admixed with the coal fertilizer and pelleted with a view to making available the initial nitrogen and other nutrients and making the colour of the fertilizer attractive to consumer and preventing adulteration.

**12.12.4 CIMPO —** It has been found that the growth of *Rauvolfia serpentina* plants and their yield of roots and seeds under forestry conditions are better when they are grown in the open instead of in shade.

12.12.4.1 The leaf spot disease of *Glycyrrhiza echinata* Linn. has been found to be due to *Cercospora* species. A new species of fungi named *Stemphylium nabarii* has been found to be responsible for *Chrysanthemum cinerarialfolium* Vis. at Bangalore.

12.12.4.2 The following plants are under cultivation: *Mentha arvensis* (1000 acres); *Pyrethrum* (50.6 acres); *Belladonna* (27 acres); *Peppermint* (5.5 acres); *Ergot* (83 acres); *Citronella* (Java) (30 acres); *Linaloe* (25 acres); *Rauvolfia serpentina* (3 acres in Mysore and 7.5 acres in Haldwani farms); *Eucalyptus citriodora* (7.5 acres in Haldwani farm); *Dill* (3 acres) and *Palmarosa* (3.5 acres).

## 12.13 Medicinal and Aromatic Plants

12.13.1.1 Extracts of 200 plants were prepared and tested for a wide spectrum of biological activities. In the preliminary screening promising anti-cancer activity was detected in 8 plants, hypoglycaemic activity in one and anti-inflammatory property in one. Extracts of three plants, *Cassia fistula*, *Cassia auriculata* and *Scutia myrtina*, were found to delay or inhibit plaque formation of vaccinia virus in chick embryo tissue cell culture. The individual alkaloids of *Berberis asiatica* roots and the non-basic constituents are being tested for anti-cancer activity.

12.13.1.2 Chemical investigation of medicinal plants has been continued. Three new alkaloids have been isolated from the leaves of *Alangium lamarckii* and named dihydroprotoemetine, ankorine and alangimarckine; the structures of the last two have been fully elucidated. The two weakly sedative saponins bacoside A and bacoside B, isolated earlier from *Bacopa monniera*, were found to be isomers; they differ only in the configuration of the carbohydrate chain. The structures of the *Cissampelos pareira* alkaloids, hayatin, hayatinin and hayatidin, have been conclusively shown to be dl-bebeerine, dl-4"- O-methylbebeerine and (+)-4'-methylbebeerine respectively, on the basis of sodium/liquid ammonia fission and NMR and mass spectral studies of the fission products. Brahmic acid, the common aglycone of brahmoside and brahminoside isolated from *Centella asiatica*, has been established to be 2,3,6,23-tetrahydroxy-28-oic-urs-12-ene. Polyglucosides of odoroside H were found to be responsible for the cardiac activity of *Carissa carandas*. From *Kochia trichophylla* a saponin has been isolated which on hydrolysis gives oleanolic acid and the sugars glucose, rhamnose and arabinose. *Paspalum scorbiculatum* was found to contain a mixture of closely related crystalline sterols; one of these, $C_{29}H_{50}O$, m.p. 140-41°C. has potent tranquillizing activity. A brownish red, crystalline substance, m.p. 112-14°C., was obtained from *Arnebia nobilis*; it shows marked antifungal and antibacterial activity.

12.13.1.3 About 500 compounds of diverse chemical types were synthesized during the year for biological evaluation. Diphenylsulphonediisothiocyanate has been found to possess marked activity against *Taenia* infection in dogs and *Raillietina* infection in poultry; it has a high therapeutic index. A new quinazolone derivative has pronounced tranquillizing action; its profile of activity is similar to that of the widely used librium. Potent anti-inflammatory activity was observed in a 3-aminopyridine derivative.

**12.13.2 RRL Jorhat —** Cultivation and improvement of drug plants have also been undertaken. One particular strain of *Claviceps purpurea* from Germany has been found to be good when tested on rye. A morphologically distinct variety of *Rauvolfia serpentina* from Garo Hills has been found to be amongst 30 specimens from different localities tested so far as the highest yielding in respect of root as well as alkaloidal content. It has also been found that plants grown in hydroponicum (Bengal system) yield better results than those in the conventional system. It has been found by field trials that of the two plants, *Cymbopogon nardus* and *C. winternianus*, the former grew better than the latter. A higher yield of oil than that obtained elsewhere has been obtained with both, namely 2·33 and 3·08 per cent respectively. A blue green algae containing 48 per cent crude protein has been obtained, the optimum growth having been found to be 5 g./day per square yard on dry weight basis.

(Ceylon) (10000 slips have been sent to Drug Farms, Jammu for further propagation); *Rauvolfia serpentina* (roots 1000 kg. and seeds 8.5 kg.); Dill (*Anethum graveolens* seeds 10.5 kg.); Peppermint herb (6.3 tonnes); and Diosgenin from Dioscorea tubers at Jammu Drug Factory 800 kg. (expected). About 1.3 tonnes of pyrethrum oleoresin are expected to be produced during 1966-67 at Srinagar Factory. Besides, the following medicinal and aromatic plants are under experimentation : *Artemisia pallens* (Davana) (Bangalore), patchouli (Bangalore and Haldwani), *Rauvolfia canescens* (Haldwani), *Ocimum kilimandscharicum* (Haldwani), *Fagopyrum esculentum* (Jammu), Datura (Jammu), *Solanum aviculare* (Jammu), *Glycyrrhiza glabra* (Haldwani and Jammu), *Cissampelos pareira* (Haldwani and Jammu), *Hyoscyamus niger* (Kashmir), *Ammi majus* (Bangalore and Haldwani) and *Rosa damescens* (Bangalore).

12.13.3.1 The following essential oils have been produced: *Mentha arvensis* oil—1960 kg. in Haldwani and 1225 kg. in Jammu Drug Farms; and production of about 1.4 tonnes of menthol has been expected at CIMPO Drug Factory, Jammu; cedarwood oil in Drug Factory, Srinagar—9 tonnes (expected); *Eucalyptus citriodora* oil—55 kg. at Haldwani.

12.13.3.2 The oil derived from *Citronella* (Java) and *Geranium* plants in Bangalore has been found to be of good quality. The oil derived from Peppermint cultivated in Haldwani Farm has been accepted by the industry.

## 12.14 Chemistry

**12.14.1 NCL —** Efforts were made to organize research work towards applied time-targeted projects aimed at optimizing processes for the manufacture of definite products or improving indigenous technology and processes. Nearly 80 such projects of immediate industrial interest were under various stages of development. In several cases industry has been motivated to participate in this effort by sponsoring these projects whereas in others, industry is expected eventually to take up the projects for commercialization.

12.14.1.1 The number of sponsored projects initiated by private industries increased to 22 from 11 in the last year. Out of these, five were completed during the year and work on 16 projects was taken up. The total number of sponsored projects including those from government agencies and P.L. 480 programme was 32.

12.14.1.2 A copper-promoted nickel catalyst for hydrogenation of oils has been developed and was found to have activity comparable to that of commercially used catalysts. Samples of the catalyst are being sent to hydrogenation factories for evaluation.

12.14.1.3 Preparation of pure silicon tetrachloride has been achieved on 1 kg./hr scale and polycrystalline silicon was successfully produced from it. Polycrystalline silicon will have immediate demand from the Indian semiconductor industry.

12.14.1.4 Chromatographic alumina and silica gel are produced on large scale in FCP (value Rs 2.5 lakhs/year). Other chromatographic absorbents are also being developed.

12.14.1.5 In collaboration with *Sirsilk Ltd,* Kagaznagar, the first step in the synthesis of sorbic acid from ketene through crotonaldehyde has been standardized. Sorbic acid is a food preservative and its potassium salt is

12.14.1.6 The know-how for the preparation of some galactosides required in genetics research has been established and two galactosides worth $ 400 have been exported to USA.

12.14.1.7 Experimental work on preparation of Dithranol, an antidermatitic agent, has been successfully completed. The project is being offered to industry.

12.14.1.8 The laboratory preparation for Saponex (*o*-tolylbiguanide) has been successfully standardized with 80 per cent yields. This speciality chemical is used as anti-oxidant for soaps and detergents, and is being imported at present.

12.14.1.9 Inulin has been obtained in high percentages from deoiled costus roots, and has been converted into fructose. The demand of fructose for diabetics and for other pharmaceutical purposes is at present met by import.

12.14.1.10 Optimum conditions for the preparation of monoethylaniline have been arrived for a continuous process on 3 to 4 kg./hr scale. On the basis of the bench scale experiments, a 100 tonnes/year plant (value Rs 10 lakhs/year) is being offered to industry. Monoethylaniline is an important intermediate required in the manufacture of carbamate type explosives.

12.14.1.11 Methylamines are widely used as intermediates in the manufacture of herbicides, fungicides, detergents, pharmaceuticals, etc. These are not presently manufactured in India and their estimated annual requirement is around 3 to 4 thousand tonnes. Work has been undertaken on the catalytic amination of methanol for the preparation of these aliphatic amines using an indigenous catalyst. Industry has shown interest in sponsoring this work.

12.14.1.12 A process development work for the manufacture of dimethyl and diethyl phthalates is being carried out on 25 kg./batch. A plant for 1500 tonnes/year of dimethyl and diethyl phthalates valued at Rs 90 lakhs is now ready for exploitation by industry.

12.14.1.13 New improvements have been effected in the preparation of styrene-DVB base cation exchange resins. The process is being offered to parties who have already taken up the original process for commercial exploitation. Optimum conditions for the preparation of styrene-DVB base anion exchange resins have been standardized on a bench scale unit. The process is now available to industry for commercial exploitation.

12.14.1.14 A process for the preparation of rubberized cork sheets having good tensile strength, compression set, resistance to shrinkage and ageing, with standard hardness number has been successfully completed and was released to a firm.

12.14.1.15 A rubber base adhesive has been successfully prepared for HAL, Bangalore for binding metal to metal and metal to rubber joints.

12.14.1.16 A new castor oil-isocyanate type composition has been developed and rollers which can be used for printing and for typewriters have been prepared. Industry has shown interest in taking up the manufacture of these rollers.

12.14.1.17 The prototype design for vapour phase chromatograph has been developed and the know-how has been offered to industry for the

12.14.1.18 Basic research of fundamental interest was continued in the following fields. Solid state physics and properties of materials used in solid state devices, synthetic inorganic chemistry of organo-titanium compounds and coordination compounds, natural organic products of potential medicinal and chemical interest, essential oils, synthetic organic chemistry of terpenes and natural and synthetic dyes, steroids etc., physical methods such as NMR and mass spectra in the structure determination of organic compounds, enzymes, microbiological transformations of terpenes, growth of plant cell, etc. Studies are also in progress on the physical and chemical properties of polymer systems and on stereospecific polymerization, ion exchange resins, surface coatings, etc. Basic chemical engineering studies are being conducted on different fluidized bed systems, thermodynamic and mass transfer properties, etc.

**12.14.2 CFTRI** — An unusual acid with characteristic ultraviolet absorption and fluorescence has been isolated from the agave stem (*Agave vera cruz* Mill).

12.14.2.1 A highly insecticidal fraction has been isolated from technical BHC in addition to the already known *gamma* isomer or lindane.

**12.14.3 CFRI** — Spectroscopic determination of germanium in Talcher coal and a sample of deposit scrapped from the inside walls of the cooler of a producer gas plant (*Oriental Gas Company*, Calcutta) showed significantly high concentration of germanium (200-300 ppm). Seven samples of Jharia coals showed germanium concentration to be either nil or less than 100 ppm. A few samples of coals from Central India, samples from boiler dust, Winkler dust, flyash, pre-cooler tar from Neyveli Thermal Power Station were spectrographically analysed for their germanium content; only the Godavari Valley coals contained about 190 ppm of germanium.

**12.14.4 CDRI** — A new method for the estimation of emetine has been developed by which it can be estimated in preparations where it occurs singly or in combination with other ingredients or in ipecac. An assay method for morphine has been developed based on the formation of a yellow complex with ceric ammonium sulphate in presence of sodium acetate. This method can be used for the estimation of morphine as such or in preparations like Morphine and Atropine Inj. and Dover's powder.

**12.14.5 NBG** — Seeds of *Cinnamomum cecidodaphne* Meissn., used extensively in the perfumed tobacco industry, have been found to contain nearly double the quantity of trilaurin present in coconut oil. As such, the seed fat has excellent possibilities of entirely replacing coconut oil in soap and detergents manufacture as well as in production of imported lauryl alcohol for wetting agents.

12.14.5.1 Thionimone, the insect repellent compound, obtained from the odorous compound and the fatty ballast of the nim oil extractive, has been found to be effective against aphids, caterpillars, coccids and white flies infesting garden plants.

12.14.5.2 The essential oil obtained from the fruits of *Cinnamomum cecidodaphne* has been fractionated and different fractions have been identified. Diosgenin and its glycoside have been isolated in pure forms from *Paris polyphylla*. The colouring matter isolated from the alcoholic extract of seeds of *Cleome viscosa* appears to be a lactone. A new colouring matter, probably

12.14.5.3 A number of new triterpenoids have been isolated and characterized from mesocarps of the fruits of *Madhuca butyracea* and *Mimusops elengi*. Contrary to the earlier view, ursane, oleanane and iso-oleanane series of terpenes have been found to be present in these plants. Studies on the seed coat of these plants and of *Achras sapota* confirm the presence of the reduced flavonoid, dihydroquercetin, along with quercitin, as a distinctive chemotaxonomic indicator of the family Sapotaceae.

12.14.5.4 Composition of fats present in the seeds of *Cosmos* spp. has been found to present a pattern different from that of fats of *Carthamus* and *Helianthus* spp., with respect to the ratios of saturated to unsaturated acid contents and linolic acid to oleic acid. Two crystalline products, showing characteristics analogous to those of calophyllolide, have been isolated from the fruits of *Calophyllum* spp.

12.14.5.5 Fresh fruit of *Blighia sapida* yielded a quinone which has been given a tentative constitution. The husk saponin showed oleanolic acid as a genin apart from hederagenin. The purified and refined seed oil has also been characterized.

12.14.5.6 About 30 seed meals, free from fat and alcohol solubles, have been analysed for their component amino acids of the seed protein; the amino acids have been found to be in general similar to those of groundnut and sesame. The high protein content of the seeds of *Jatropha curcas* compares well with that of *Melia indica*. Processed seed meals of 12 species *Achras sapota* (1.9), *Amoora rohituka* (3.14), *Abutilon hirtum* (2.3), *Calophyllum apetalum* (4.0), *Sasbania grandiflora* (4.9), *Bridelia retusa* (7.5), *Madhuca butyracea* (6.2), *Cosmos sulphureous* (6.3), *Gelonium multiflora* (10.0), *Jatropha gossypifolia* (9.0), *Bauhinia triandrarosea* (9.1) and *Lagerstreomia indica* (1.1) have been analysed for their nitrogen content (percentage given in brackets).

12.14.5.7 Alcohol extraction of neem oil, in one-ton batches, has been in progress. Tentative cost data with regard to loss of solvent (rectified spirit) and utilities, which have been calculated for 3 tons of processed neem oil indicated the method to be economical. It is expected that the use of steam in partial replacement of power may further reduce the cost of utilities.

12.14.5.8 Soap samples (5-10 kg. lots), prepared with neem oil (85%), *Salvadora* fat (10%) and *Mahua* fat (5-10%) have been found to possess good keeping quality and desired lathering properties.

12.14.5.9 In partial modification of the earlier process, the bitter constituents, present in alcoholic extraction from neem oil, are being separated from the odorous constituents and the fatty ballast with the help of dilute alcohol in place of hexane.

**12.14.6 CSMCRI** — The following physico-chemical investigations on sea and inland brine concentrates and on salt and other evaporites have been carried out: Determination of vapour pressure of bitterns of different densities; kinetics of deposition of evaporites during solar evaporation; heavy water concentration in brines and bitterns, and crystalline magnesium chloride; and calcium sulphate content in the whole range of concentrated brines as correlated in terms of activity coefficients and solubility product.

12.14.6.1 Detailed study has been made on potassium bearing mixed

tion studies were carried out on synthetic double salts of potassium, viz. potassium schoenite and kainite.

12.14.6.2 Study of quaternary system consisting of potassium, aluminium and magnesium chlorides and water at 25°C. has been made and surface chemistry of calcium trisilicate hydrate and precipitated silica has been studied in detail.

12.14.6.3 Natural radioactivity associated with sea weeds and sea-water concentrates has been determined. Influence of Co-60 γ-radiations on the gel strengths of agar and sea weed extracts has been studied. A simple chemical dosimeter for γ-radiations using ammonium molybdate in ethanol and tetrahydrofuran solvents has been developed.

12.14.6.4 Comprehensive studies have been made on distribution of impurities in solar salt and on role of the impurities in moisture absorption by salt. Modification of crystal habit of salt has been observed during solar evaporation of brines in presence of manganese sulphate (in trace amounts) and other additives.

**12.14.7 RRL Hyd. —** Conditions have been worked out to quantitate the separations obtained by thin layer chromatography, adopting charring of the separated components under reproducible conditions followed by densitometric scanning of the charred spots in a suitable recording instrument.

12.14.7.1 A colour test for the detection of red palm oil to the extent of 5 per cent in cow and buffalo ghee and to somewhat higher extents in various vegetable oils was standardized. It has been shown that in two cases where unusual fatty acids occur in the seed fat glycerides, the same acids are not present at all in the phospholipid component of the same seed. The work is being extended to other oilseeds. Preparation of fatty alcohols and fatty oils on a 20-litre scale has been successfully accomplished.

12.14.7.2 A composition based on cashewnut shell liquid (CNSL) has been found quite satisfactory in raft exposure tests at Bombay as an anti-corrosive paint for ship bottoms. It is being tried by the Naval Dockyard, Bombay, on a small ship.

12.14.7.3 A method has been developed for fractionation of nucleic acids using zinc ions. By this method transfer RNA loaded with amino acids can be separated from unloaded transfer RNA, and total RNA from DNA. Evidence has been obtained for the presence of RNA in extracellular compartment of liver.

12.14.7.4 Evidence has been obtained for the suggestion that one of the functions of intercellular organization in liver, particularly cell contact and intracellular material, is to regulate the permeability properties of the organizing cells. This finding is of importance from the point of view of understanding the mechanism of carcinogenesis.

12.14.7.5 Process for the preparation of a few perfumery chemicals has been worked out on laboratory scale on behalf of *Hindustan Lever Ltd*, Bombay and work on pilot plant scale has been taken up.

12.14.7.6 To investigate the nature of black pigmentation in the wood of *Ebenaceae*, particularly the *Diospyros* species, and its role in imparting strength and durability to the wood, a few species have been examined

Roxb. (Coromandal ebony) four new naphthaquinones and a naphthalene derivative have been isolated and characterized; they appear to have useful biological activity.

12.14.7.7 A novel dimeric form of naphthaquinone, Diospyrin, has been found in the wood of *Diospyros montana* Roxb. and its structure elucidated. Diospyrin co-occurs with its monomer and two new naphthalene derivatives in the wood of *Diospyros chloroxylon* Roxb. This co-occurrence has biogenetic implications.

12.14.7.8 Sterilization of male insects by exposure to the chemosterilant 'Apholate' has been used to control red cotton bug, a pest on the cotton plant. Small-scale experiments show that sterile males compete with the normal male for a mate and in the succeeding generation the population declines by 90 per cent. In the control experiments the population increases threefold.

12.14.7.9 Chlorination of pure xylenols has resulted in products with high bactericidal properties.

**12.14.8 RRL Jammu —** As earlier strains of ergot produced contained mainly ergotoxine and not ergotamine or ergometrine which are in great demand by the pharmaceutical industry, a new strain (R55) has been introduced. This contains ergotamine to the extent of 0.192-0.33 per cent. A large scale extraction has yielded the alkaloid to an extent of 0.288 per cent. Another strain, R56, has been found to be superior to R55. Spectroscopic estimation indicated the alkaloid contents varying from 0.36 to 0.6 per cent in a single sclerotia of R56. A procedure has been evolved and adopted for the extraction of the alkaloids.

12.14.8.1 The difficulty of powdering dioscorea tubers has been solved by soaking the tubers in water for 2 days. Trials of recovery of diosgenin have yielded 90 per cent recovery. By acetylating diosgenin with acetic anhydride and the pyridine hydrochloride solution pseudo-diosgenin has been obtained. This on oxidation with chromic anhydride in acetic acid medium yielded 16-dehydropregnenolone acetate in 60 per cent yield. This is a commercially important product to get progesterone.

12.14.8.2 Starting from dilapiole, a byproduct of the Indian dill oil industry, a number of derivatives have been prepared via dimethoxy piperonylic acid. Out of these compounds, the ethylamide and the ethyl ester showed maximum activity against insects and some of them also enhanced the activity of pyrethrum.

12.14.8.3 Oleoresin of ginger has been obtained in 20 per cent yield from ginger rhizomes by extraction with purified alcohol.

12.14.8.4 Criteria for establishing the identity of oil from pepper and cardamom by thin layer chromatography have been worked out by collaborative work with the Food and Drug Directorate of Canada.

12.14.8.5 Criteria for identifying dihydrocarveol, citronellol, *trans*-carveol, geraniol, nerol, linalool, methyl octanol, rhodinol, piperonal, pulegone, thujone, citronellal, benzaldehyde, methyl nonyl ketone, citronellyl oxyacetaldehyde, anisic aldehyde and limonene oxide have also been established on similar lines.

Jammu, a process has been developed for obtaining the total alkaloids in a white amorphous form as there is demand in the country for them. The composition of the product is hyoscyamine, 70; hyoscine, 16; atropine and other minor alkaloids, 14 per cent. The preparation has received market acceptance.

12.14.8.7 A method for the production of rutin on a commercial scale from the leaves of *Fagopyrum esculentum* was developed and passed on to the Drug Research Laboratory, Jammu, for exploitation.

12.14.8.8 A promising variety of *Eucalyptus citriodora* with desired odour qualities has been found.

12.14.8.9 Two interesting species of *Elsholtzia* have been discovered and detailed investigations carried out on their oils. One of the species yielded a component having mango like flavour. Its utilization in fruit and beverage industries is being tried. The second species contains 60-70 per cent of thymol and may prove an economic raw material for the production of this chemical.

12.14.8.10 Phytochemical investigations led to the isolation of 18 alkaloids from 12 *Crotalarias* species. Some of these alkaloids have displayed highly potent, hypotensive activities. Some of them showed interesting antiviral effects and also produced mutations in plants.

12.14.8.11 Some of the alkaloids isolated from *Piper* species showed coramine and metrazol type of activity on the heart. One of the alkaloids was found to be a highly potent insecticidal and larvicidal agent.

**12.14.9 CIMPO —** Essential oil from *Satureia hortensis* Linn. has been produced on an experimental scale in Bangalore. The oil obtained in yield of 0.15 per cent has been found to be acceptable from the point of view of flavour and contains 38 per cent of phenol as carvacrol.

12.14.9.1 The oil of *Cymbopogon nardus* produced at Lucknow has been found to be acceptable by the perfumery industry. It contains 46.5 per cent of total alcohols as geraniol and 8.0 per cent of total aldehydes as citronella.l

12.14.9.2 Bellary leaf (*Litsea zeylanica* Nees) oil has been produced experimentally and its physico-chemical constants have been determined. The oil may find a good market as a flavouring agent.

12.14.9.3 The root bark of *Bursera delpechiana* Poiss ex Engl. has been found to contain 0.27 per cent of oil (w/w) having characteristic linaloe odour. The wood has been found to be devoid of oil.

## 12.15 Biochemistry

**12.15.1 CFTRI —** In studies on *iso*-citric dehydrogenase—a key enzyme in the citric acid cycle—formation of enzyme bound carbon dioxide involving a sulfhydryl group of the enzyme as an intermediate step has been experimentally demonstrated. This represents a unique phenomenon in enzymatic carboxylations involving carbon dioxide.

12.15.1.1 Plant mitochondria isolated from French beans have been found to behave differently from animal mitochondria in that ATP does not

**12.15.2 RRL Jammu —** Citric acid is required in quantities of the order of about 1,500 tons per year for both food and pharmaceutical industries in the country. Last year, the country imported 1,200 tons of citric acid worth Rs 41 lakhs. The modern method of manufacture of this acid is by the submerged method which is most economical. At present, no citric acid is being manufactured in the country by submerged fermentation method. There is a factory set up in Bombay but it is understood this is not in production due to technical difficulties.

12.15.2.1 Laboratory work on the production of citric acid has been going on in a few laboratories in the country but the industrial method does not appear to have been worked out so far. This laboratory started work on the production of citric acid by submerged fermentation method in November 1965. After screening about 1000 *Aspergillus niger* cultures, 6 cultures have been isolated which give about 80-85 per cent conversion of sucrose into citric acid in the submerged culture in shake flasks. This appears to be the first time when this has been achieved in the country. The strains isolated by the laboratory are not sensitive to iron.

12.15.2.2 Laboratory studies are being stepped up in 14 litre small fermentors. Steps have been taken to install a pilot unit to study this process in greater detail to obtain data to design the commercial unit for the production of the acid.

12.15.2.3 Twenty heptaenes having very high antifungal activities ranging from 0.5 μg./ml. to 2μg./ml. *in vitro* have been isolated from *Steptomyces* cultures. Fifteen of these antibiotics constitute a new structural group of heptaenes. They contain the aminosugar, mycosamine, and the aromatic moiety, *p*-aminobenzaldehyde which is aldolically bound to the rest of the molecule. None of the heptaene antibiotics reported in literature contains this type of aromatic moiety. Two of these antibiotics, X-2510 and X-2110, have been found to be new ones. Five heptaenes have been found to belong to trichomycin, ascosin and candicidin group. They contain mycosamine and *p*-aminoacetophenone.

12.15.2.4 Based on the presence of the aminosugar moiety and the aromatic moiety in heptaene antibiotics, classification of Borowski (1961) has been modified suitably. This work was done in collaboration with Prof. E. Borowski, Biochemical Institute, Gdansk, Poland.

## 12.16 Chemical Technology

**12.16.1 NCL —** A new pilot plant has been installed for the preparation of phthalates and other plasticizers. On the basis of pilot plant trials of 50-75 kg./batch, processes for dioctyl and dibutyl phthalates have been completed and engineering designs have been released to a firm who have tendered for *Hindustan Organic Chemicals Ltd*, a turnkey plant for 10,000 tonnes/year (value, Rs 6 crores) with guarantees for performance. Similar offers are being made to private industry. Processes for the manufacture of diethyl phthalate and dimethyl phthalate have been standardized and have been offered to industry.

12.16.1.1 Work on the chlorination of titanium bearing materials has now been undertaken on sponsored basis. A 10 kg./hr of titanium tetrachloride pilot plant was fabricated for the sponsor and run successfully.

Production of titanium tetrachloride from the plant will save foreign exchange of about Rs 7.5 lakhs annually.

12.16.1.2 In the fine chemical project about 300 research chemicals and chemicals of strategic importance are being produced. Value of the production and sales during 1966 are Rs 2,04,143 and 1,40,349 respectively.

12.16.1.3 Acid prehydrolysis sulphate and 2-stage alkaline pulping processes are being tried on different indigenous cellulosic raw materials like *Eucalyptus hybrid*, *Shorea robusta*, etc. Part of this work is now sponsored by industry.

12.16.1.4 Chemical engineering designs of a batch process for dimethylaniline have been finalized on a 9 kg./batch pilot plant and the process is being offered to industry (600 tonnes/year valued Rs 21 lakhs/year).

12.16.1.5 A continuous process for the manufacture of aniline by hydrogenation of nitrobenzene has been optimized on a pilot plant scale (6 kg./hr of aniline). These processes are being offered to industry. A 600 tonnes/year unit for the production of aniline (value Rs 78.8 lakhs/year) is being designed.

12.16.1.6 Several pilot plant trials on the carbonation of β-naphthol for the manufacture of BON acid (3 kg./batch) have been successfully run and earlier results reproduced. The work is being extended to the carbonation of phenol to salicylic acid.

12.16.1.7 Pilot plants on fine chemicals, dissolving pulp, BON acid, chlorination of ethylene, aniline and dimethylaniline are being continued.

12.16.1.8 The foundation of a new plant for the extraction of opium alkaloids was laid at Neemuch (M. P.) The estimated production of this plant, following the NCL process, is expected to be 4.7 tonnes a year of S. R. Morphine valued at Rs 1 crore per year.

12.16.1.9 Large scale pilot plant demonstrations were successfully given to *Hindustan Antibiotics Ltd* (HAL), Pimpri at their site for the preparation of vitamin C by NCL process. HAL is putting up a plant for 125 tonnes/year valued at Rs 94 lakhs.

12.16.1.10 *Hindustan Organic Chemicals Ltd* (HOC), Rasayani has selected NCL process from amongst the world tenders invited for the manufacture of acetanilide. A plant for 2000 tonnes'/year of acetanilide valued at Rs 1 crore will be put shortly by HOC. The plant has been offered to HOC on a turnkey basis with financial guarantees through *R. L. Dalal & Co.*

**12.16.2 CFRI —** Investigations on oxidation of naphthalene both pure and hot-pressed crude (m.p. 78°C.) with oxygen enriched air using F. R. I. catalyst were carried out. It was found that at a temperature above 400°C. there was no unconverted naphthalene and the yield of phthalic anhydride was about 65 per cent. The percentages of other products obtained were: maleic anhydride, 5; quinones, about 6-8; and acetone soluble resinous mass, about 6.

12.16.2.1 A semi-pilot plant for the production of anthraquinone by catalytic vapour phase oxidation of anthr cene in a fluid-bed reactor was designed, fabricated and erected. Experimental runs were given at 380°C. and it was found that the reaction was of the first order. The temperature

12.16.2.2 Investigations were conducted on the extraction of tar acids from low temperature tar (boiling up to 270°C.) by aqueous ammonia. For the extraction, 4 per cent ammonia concentration was found to be optimum. Using butyl acetate and isopropyl ether as dephenolizing solvents, the extraction efficiency was 80-90 per cent.

12.16.2.3 Phase equilibrium studies for the extraction of tar acids from tar oils (boiling up to 270°C.) by aqueous acetamide was completed and the theoretical stages required for counter-current extraction of tar acids have been established. The maximum tar acid concentration possible in the extract, after solvent removal, has been found to be 84 per cent.

12.16.2.4 A method has been developed for the analysis of lower boiling monohydric phenols present in ammoniacal liquors by a technique of counter-current distribution. The phenols were also determined by the chromatographic method and the results tallied confirming thereby the reliability of the method developed.

12.16.2.5 A gas-liquid chromatograph was set up and standardized for its operation. Three GLC columns (6 ft, 6 ft & 10 ft) were ultimately prepared in copper tubes. Tar acids from synthetic oil (coal hydrogenation) were analysed by GLC. Crude phthalic anhydride, neutral oil (170-250°C.) and six other hydrocarbon samples produced synthetically were also analysed.

12.16.2.6 Catalytic vapour phase oxidation of *alpha* and *beta*-methylnaphthalenes was studied using ferric vanadate as the catalyst and potassium sulphate as the moderator supported on silica gel and also on pumice. The effect of injecting deuterium oxide on controlling the temperature of reaction and as an aid to the study of reaction mechanism was also attempted.

12.16.2.7 Isomerization of alkyl naphthalenes in vapour phase over an alumina-boria catalyst was also studied by analysing the products formed by infrared spectroscopy. Nearly 70 per cent yield of naphthalene was obtained. Similar experiments on disproportionation of toluene yielded benzene. Vapour phase isomerization of *m*-xylene under different conditions was detected by infrared spectra. Catalytic transformation of *m*-xylene into *o*-and *p*-xylenes (which are used as starting materials for producing phthalic anhydride and high quality polyester fibres respectively) was carried out with aluminium nitrate on silica gel catalyst in tubular furnace heated electrically (475-555°C.) and the reaction products analysed by infrared spectroscopy.

12.16.2.8 The results of investigation on production of active carbon from coconut shells, carried out at the request of a party in Kerala revealed that a high capacity product useful for adsorption of sulphur (inorganic and organic), benzene, carbon tetrachloride, etc. could be prepared. A project report has been prepared.

12.16.2.9 Semi-anthracites from Metka and Bergoa Blocks of Jammu coalfield were analysed to find out their suitability for the production of electrode carbon.

12.16.2.10 Experiments were conducted to condense benzene, phenol and tar acids separately with keryl chloride or cetyl alcohol using anhydrous $AlCl_3$ as the condensing agent; conc. $H_2SO_4$ was also used in case of

detergent, keryl phenol sulphonic acid (Na-salt), a semi-solid compound (alcohol soluble), obtained from the reaction of cetyl alcohol-benzene—concentrated sulphuric acid which lowers the surface tension of water and has considerable foaming property, cetyl tar acid sulphonate and keryl tar acid sulphonate.

12.16.2.11 The activities of the iron F. T. catalysts, prepared from ferrous, ferric or ferrous-ferric (75 :25) iron, are quite different. In order to study this, argon and nitrogen were used for the adsorption studies with a catalyst prepared from ferrous-iron, and isotherms at—195°C. were obtained. Isotherms were also obtained for the partially reduced catalysts. Uptake of argon and nitrogen was comparatively less in case of the reduced catalyst. Rates of CO-adsorption on the same catalyst was determined at different temperatures (150, 175 and 200°C.) with a view to probing into the kinetics of the reaction.

12.16.2.12 In a specially designed reactor (3 in. int. dia.) study of the effect of different variables in the fixation of nitrogen in South Arcot lignite was carried out. Under the optimum conditions as much as 21.9 per cent (d.a.f.) nitrogen could be fixed in lignite samples. A 7 in. dia. reactor column was then tried for the production of fertilizer from lignite and nitrogen of the same order could be fixed in lignite. Coal fertilizer was produced from Talcher and Umrer coals in the 7 in. reactor column and about 15-16 per cent nitrogen on d.a.f. basis could be fixed in these coals. A coal fertilizer plant of 2 tons/day capacity has been put into operation.

12.16.2.13 Coal fertilizers were prepared from coal of lower rank from Singareni, Singrauli, Talcher and Korba and a total of 22 per cent nitrogen (d.a.f.) could be fixed of which one third was in the available form.

12.16.2.14 A bench-scale unit for the catalytic conversion of organic sulphur to $H_2S$ has been set up. Activated iron-based catalyst was used for a feed gas consisting of hydrogen enriched with $CS_2$ vapour. About 98 per cent conversion efficiency was achieved.

12.16.2.15 Regular analytical work for the numerous samples of coal, coke etc. received from outside parties and also from other divisions for investigational work was carried out. A method has been developed for the rapid quantitative estimation of sulphur and nitrogen in coal or coke by fusion with magnesium powder.

12.16.2.16 Standard curves for titanium and phosphorus were drawn with the help of Spekker absorptiometer and those for sodium and potassium were drawn with the help of flame-photometer.

**12.16.3 CDRI —** A process for the production of thiacetazone, a tuberculostatic agent, has been developed. A project report for the manufacture of 12 tonnes annually has been prepared and the process has been handed over to a firm. Processes for furacin, an antibacterial agent, dapsone, a drug for leprosy, and dichloro-8-hydroxyquinoline used in the treatment of dysentery, have been developed and their project reports have been prepared.

**12.16.4 CECRI —** Preparation of lead dioxide powder from lead monoxide has been attempted by electrolysis of sodium chloride solution to [illegible] hypochlorite and suspending yellow lead monoxide in the

12.16.4.1 Investigations on the electrochemical preparation of copper oxychloride were carried out using a divided cell with soluble copper and graphite anodes and iron cathode.

12.16.4.2 The efficiency of indigenous CNSL resin developed at NCL, Poona was compared with that of Amberlite IR 120 for analytical work. The resin has been found to compare well with Amberlite resin in the analysis of chlorides, chlorates and perchlorates of sodium or potassium. The indigenous resin has been found to give better results than Amberlite IR 120 in the case of mixtures of chloride-chlorate, chloride-perchlorate, chlorate-perchlorate and chloride, chlorate and perchlorate.

12.16.4.3 A number of mercurous and mercuric salts have been tried as electrolytes for elapsed time indicators which can directly indicate the accumulated hours of operation of any equipment utilizing a.c. or d.c. power and which can also perform coulometric integrations. This device is likely to find applications in military, radar and other electronic and mechanical equipments wherein the operating time must be lagged as a part of maintenance procedure.

12.16.4.4 A bath consisting of copper sulphate, sodium, potassium tartrate, sodium hydroxide and glycerine on reduction with dilute solutions of formaldehyde under suitable conditions has been found to give smooth adherent deposits of copper on mild steel.

12.16.4.5 The following projects bearing on import substitution have been completed or under progress: Mechanically grained zinc plates and imported aluminium plates are at present being used for lithographic work in India. A process has been worked out successfully using indigenous raw materials for the preparation of aluminium lithoplates and has been handed over to industry. Printing trials of the plates in a lithopress have shown them to be as good as imported aluminium lithoplates and better than conventional zinc plates. It is estimated that their indigenous production would save foreign exchange to the extent of Rs 30 lakhs per year.

12.16.4.6 A process has been worked out for the production of misch metal from rare earth chloride, a byproduct obtained in the separation of thorium from monazite sands at the *Indian Rare Earth Ltd*, Alwaye. A unit of capacity 10 kg./day has been operated successfully. Misch metal which is at present imported, finds application in the production of cigar lighters, gas lighters, hand grenades and in the spheroidal graphite cast iron. The process has been released to a party.

12.16.4.7 Studies on the life of lead dioxide coated graphite anodes have been carried out using them in cells (200 and 800 amp.) for manufacture of sodium chlorate. The 800 amp. cell was run for over 20 months. The studies have revealed that the life of the lead dioxide coated anodes is nearly four times that of graphite electrodes.

12.16.4.8 Potassium perchlorate (21 tons) and of ammonium perchlorate (1000 kg.) have been prepared in cells using platinum anodes or lead dioxide anodes, and supplied so far to organizations requiring them. Perchlorates are not at present produced in the country by commercial firms.

12.16.4.9 Know-how for producing magnesium silver chloride and magnesium cuprous chloride has been developed, using sintered silver

electrodes. The magnesium-silver chloride batteries find application in specific equipments used by the Naval departments; they are at present being imported. The magnesium-cuprous chloride batteries are used by the meteorological departments for use in radiosonde, etc. Suitable fluxes have also been developed for soldering of magnesium with tin or tin alloys.

12.16.4.10 Know-how has been developed for detinning and the recovery of pure metal from tin scraps. Recovery of tin to the extent of 500-750 tons/year (value, over Rs one crore) can be obtained by the end of Fourth Plan.

12.16.4.11 A new electrophosphating process has been developed. It has the following advantages over the existing processes: (i) it gives a fine grained, silky coating without affecting the gloss of enamel applied on it; (ii) the intrinsic corrosion resistance of the coating obtained is of a high order unlike coating obtained in existing processes which show rusting in the unsealed condition; and (iii) it is possible to effect substantial saving in cost of painting.

12.16.4.12 A process has been worked out successfully for the production of magnesium electrolytically from Salem magnesite or bitterns, and unit of capacity 12 kg./day has been operated. A spray drier has been designed and fabricated for the preparation of anhydrous magnesium chloride, and an electrolytic cell of 2000-2500 amp. capacity has also been designed, fabricated and operated successfully. The present requirements of magnesium metal are met by imports.

12.16.4.13 Benzidine and substituted benzidines find wide applications as intermediates in the dyestuff industries and are largely used in the synthesis of azo dyes. Benzidine also finds application for detection of sulphates in water and identification of blood. Presently benzidine, dianisidine and tolidines are imported. The total import of benzidine and benzidine dihydrochloride in 1965-66 was 314, 232 kg. valued at about Rs 1.6 millions. The process has been released to a party. Samples of the product produced in the laboratory were sent to a number of firms for trials. They have reported suitability of the product for their use.

12.16.4.14 Use of Kraft paper coated with vapour phase corrosion inhibitors as a lining inside the casing or package has been found to be effective for the preservation of engineering items like bolts, nuts, screws, etc. It is also more convenient than using other types of temporary corrosion preventives like greases, oil, etc. Research work at the Institute has shown that vapour phase inhibitors (VPI) based on the by-products of coke-oven plants could be effectively used as preservatives for wood-screws, nails, bolts, etc. Practical trials conducted in collaboration with various firms have yielded satisfactory results. It has been estimated that several millions of sq. ft of VPI coated paper will be required for anti-corrosion packaging of various engineering stores. This invention is of special significance in view of restrictions on the import of VPI coated papers.

**12.16.5 RRL Jammu —** A number of vegetable tannin materials have been screened. *Polygonum amplexicaule*, pomegranate rind and Babul bark have shown promising results.

12.16.5.1 Some of the locally available species were examined for pul- [illegible] different methods. In the case of *Ipomoea carnea* cellulose and 2.9 per cent pentosans. Waste deodar sawdust, left after the distillation of the essential oil, and fir sawdust also gave an yield of over 35 per cent bleached pulp having 85 per cent *alpha*-cellulose by sulphate process.

12.16.5.2 It has been found that the raw oleoresin of *Pinus longifolia* has more conjugation than rosin. The esterified maleic adducts have been found to have better water proofing properties than similar rosin composition.

12.16.5.3 A process has been developed to minimize the silicate impurities in hydrous calcium sulphate mineral and almost eliminate the carbonaceous impurities to make the material suitable for the manufacture of Surgical Grade Plaster of Paris.

12.16.5.4 A technique has been developed for refining the pyrethrins contained in the oleoresin of pyrethrum flowers so as to make it suitable for use in aerosols.

12.16.5.5 Work on the selection and improvement of Pyrethrum has yielded plants with increased number, and total weight of flowers per plant as well as higher percentage of pyrethrin (being 1.2% in 2 year old crop). These clones are now being multiplied for commercial exploitation in Kashmir.

12.16.5.6 A haploid form of Jammu mint with thinner stems and leaves was found to combine hardiness with early maturity and to have oil content equal to that of Japanese mint. Its earliness can be utilized for harvesting an early crop thereby make available to the industry raw material over a longer period for distillation.

12.16.5.7 Tetraploid *Mentha piperita* was found to be more robust than diploid even though its oil content was not increased. It has been introduced on trial at the Srinagar farm.

12.16.5.8 A high polyploid of *Mentha citrata* has been found to contain linalool. Its cultivation and improvement has been taken up in Srinagar.

12.16.5.9 Hybrid vigour noted on crosses between *Datura metal* × *D. festuosa* was found useful in large scale cultivation of this species. A higher alkaloid yielding polyploid of *D. innoxia* was obtained after treatment with alcohol and colchicine. It has been established that there is direct relationship between polyploidy and oil content in several species of *Cymbopogon*. A survey of *Cymbopogon* yielded a new species of high oil bearing type from Ladakh provisionally named as *C. ladhakina*.

12.16.5.10 Much disputed varieties of *C. martini* 'Motia' and 'Sophia' giving different oil contents have now been differentiated on cytological, morphological and chemical grounds. On this basis, their commercial utilization can be taken up easily.

12.16.5.11 *Asparagus officinalis* has been sufficiently improved and has already been given to departments of Horticulture and Industry of Jammu and Kashmir Government for commercial growing in Kashmir Valley.

12.16.5.12 A maximum yield of 386.8 quintals of green herb/hectare *Mentha arvensis* was obtained by using 450 kg. of suckers at 60 cm. spacing.

**12.16.6 RRL Jorhat —** Furfural in 5 per cent yield has been obtain- [illegible]

sulphonat emetal salts have been prepared from sulphite liquor from paper factories. The salts which are at present imported are being evaluated for their suitability as drilling mud additives.

12.16.6.1 Cinnamon leaf oil is at present imported to the tune of Rs 7 lakhs annually. It has been possible to obtain the oil from the leaves of *Cinnamona tamala* in an yield of 2 per cent.

12.16.6.2 Methods of recovery of sulphur from Assam coal in which it occurs have been worked out. It has been possible to recover sulphur as sodium sulphite, ammonium sulphite and calcium sulphate from the flue gases obtained by burning Assam coal and the organic sulphur as $CaSO_4$, $H_2SO_4$ or elemental sulphur.

12.16.6.3 A 30 tons/day vertical shaft cement plant has been designed, fabricated and perfected. The plant has been operated for cement production using coke-breeze and Assam coal as fuel, as well as by not using gypsum.

12.16.6.4 Investigations have shown that plain roofing sheets and corrugated roofing sheets conforming to IS specifications can be produced by adding 3-5 per cent and 10 per cent bamboo pulp respectively to cement paste. Both the types of sheets were found to be chemically resistant and with in the specified moisture absorption limits. This project, if made use of, can save foreign exchange of Rs 10 crores incurred in importing asbestos for making asbestos sheets.

12.16.6.5 It has been shown that locally available soil can be made use of for making bricks of suitable strength by mixing 6-8 per cent of lime with the soil and compressing the mixture to maximum density at optimum moisture content.

12.16.6.6 Studies have shown that phenol could be recovered from coking gas oil in a yield of about 1.2 per cent by extracting it with alkali.

12.16.6.7 Preliminary findings on blending of petroleum fraction (b. p. 125-150°C.) with kerosene so as to get a fraction having boiling range of 125-290°C. instead of 140-290°C. were encouraging. Increased yield of satisfactory quality of kerosene can be obtained.

12.16.6.8 A process for deinking of old newspapers and subsequent recovery of newsprint has been worked out. In this process, old newspapers are pulped at an elevated temperature after treating with suitable chemicals and the ink particles are subsequently removed from the pulp by using froth flotation technique. This process is expected to save considerable foreign exchange incurred in importing newsprint. A process for pulping waste paper from the Government Security Press, Nasik, has also been developed as it is not possible to pulp it using conventional technique. This process has been worked out on behalf of *Vidarbha Paper Mills Ltd*, Nagpur. Considerable progress has also been made in the development of processes for (i) making electrical insulating papers using PF resin, shellac, varnish, etc. as coating material, (ii) deinking of waste paper like letter heads, records; (iii) producing high strength and high bursting quality papers from pulp after subjecting it to partial acetylation, carboxy and hydroxy ethylation; (iv) manufacturing matrix board (stereo Flang) for use as printing

12.16.6.9 The process of making particle boards from sawdust using water as the only binder (without use of urea-formaldehyde resin) has been extended successfully to the use of other agro-industrial wastes like bagasse, paddy husk, groundnut husk, spent tan materials. Improvements to the process by way of pressing at a lower temperature and using lesser quantities of the dehydrating agent have also been effected. A corrugated oil heating system has been indigenously fabricated and water-proof corrugated particle boards have been successfully produced. These boards are expected to be substitutes for costlier roofing materials.

**12.16.7 RRL Hyd.** — An activated earth has been developed from Korvi fuller's earth. It is specially suitable for bleaching of sesame oil without effecting removal of sesamin.

12.16.7.1 A dual-purpose fertilizer containing potassium and phosphorus as nutrient has been developed and found to be specially suitable for acidic soils. The fertilizer does not require any mineral acid for its preparation.

12.16.7.2 Know-how has been developed for making nickel formate from nickel and nickel catalyst from the formate and for the production of potassium permanganate from pyrolusite.

12.16.7.3 Microwave ferrites have been developed which have special application in the fabrication of components required by a Defence laboratory. Performance of the ferrites is equal to that of imported ones.

12.16.7.4 Enamel compositions have been developed for glass lining of mild steel equipment. The glass lining compositions are found to be quite satisfactory in resistance to chemical attack and thermal shock.

12.16.7.5 Consequent to the successful development of a process for synthesis of abrasive grade silicon carbide grains, an experimental unit to produce about 70 kg. of grain per day is in operation.

12.16.7.6 A continuous bench-scale unit has been set up for the manufacture of monochloroacetic acid, an important chemical required in the manufacture of 2-4-dichlorophenol, carboxymethyl cellulose, etc. A continuous process for the manufacture of benzal chloride and benzotrichloride has been developed on a bench-scale unit.

12.16.7.7 A process for the manufacture of edible grade cottonseed flour has been developed. The flour is rich in proteins, and incorporation in foods will go a long way in supplementing the nutritional quality specially of vegetarian diets. The laboratory is at present supplying the flour to the pharmaceutical industry, which has been so far dependent on imported flour.

12.16.7.8 An adopter for the single crystal camera (Unicam) was designed and fabricated which enables the new goniometer head (of the Buerger Precision camera) to be fixed with the Unicam camera. This arrangement enables one to use both the cameras using a single gonometer head. A reflux timer has been developed for use in control system for reflux dividers in any distillation process at pilot plant level. All components, except the vacuum tubes, have been indigenously manufactured. A taut suspended platinum wire type thermal conductivity cell has been developed for use as a detector unit in gas-liquid chromatography.

Institute. Field experiments in the salt farm have shown that traces of manganese sulphate increase the evaporation of brines by 6-10 per cent and enable compact salt crystals to be formed. Polythene lining of crystallizer beds has been used at Shiroda salt works for preventing percolation of brine. Both power-driven and tractor-pulled mechanical harvesters have been fabricated and tried in the salt farm of the Institute and also at other salt works. Soil samples from salt works at Tuticorin, Saurashtra and Sambhar (Rajasthan) have been studied with the object of working out suitable methods for reducing percolation of brines and increasing bearing strength of salt pans for use of mechanical harvester. Studies on washing characteristics of salt from different regions have been completed and suitable equipment for the washery plants has been designed.

12.16.8.1 Laboratory studies on the preparation of the potassium carbonate using ion-exchange technique have been completed. Optimum conditions have been worked out for the recovery of sodium sulphate by flotation of Sambhar solid bittern. A 12 kg. per 24 hr unit has been set up to produce ethylene dibromide.

2.16.8.2 An electrodialysis unit (capacity, 225 litres fresh water/24 hr) has been set up to desalt brackish water. A 1500-litre per 24 hr unit has been designed and fabricated. A humidification-dehumidification unit with a capacity to produce 135 litres of fresh water from sea water has been set up. A 4.5 kilo litre per day plant has been designep and is under construction.

12.16.8.3 The semicommercial plant set up at Kandla to produce 3 tonnes of potassium chloride and 7.0 tonnes of epsom salt per day has commenced production.

**12.16.9 NPL —** For preparation of a suitable filter for transmission in the near ultraviolet region in a certain investigation, a cement was needed for joining quartz plates. For this purpose the usefulness of Saleya Balsam was studied. The material is obtainable easily from an indigenous gum-oleoresin of *Boswellia serrata* (Saleya). The characteristics of the Saleya Balsam namely, refractive index, reciprocal dispersive power, spectral absorption at 33 mm. tensile strength and shear strength compare very favourably with those of Canada Balsam. The joints obtained by either balsam have been found to be free from any strain pattern.

### 12.17 Fuels, Oils and Lubricants

**12.17.1 CFRI —** The seven Coal Survey Stations at Jharia, Raniganj, Ranchi, Bilaspur, Nagpur, Jorhat and Jammu are engaged in the work of determining physical and chemical parameters of coal from borehole cores or seem samples, besides undertaking investigations on washability characteristics and/or on carbonization potentialities so as to get an indication of suitability of different coals for industrial use.

12.17.1.1 Quality assessment and carbonization assay tests were conducted on the bore-hole coal cores from Barren Measure of Jharia coalfield (drilled by National Development Corporation), from Ramgarh, Karanpura and West Bokaro coalfields (drilled by the Geological Survey of India) and from Parbatpur, Mahal, Kapuria and Raniganj Measures of Jharia coalfield. It has been found that coals from Parbatpur Block could be used in metallurgy after washing and that the [illegible] of eight samples of coal from Gidi Bachra and Bhurkunda Blocks. VIII Seam coal was found difficult to clean even in fine sizes by washing.

12.17.1.2 Physical and chemical survey of the Gopinathpur seam (Barakar Measures) was carried out in the Coal Survey Laboratory, Raniganj. The coals were found to be weakly caking (CI,10) containing high ash (37-42%), low moisture and having poor washing characteristics. Qualities of coals from Dishergarh Block C and Bhanora Block No. 1 and from Mejhia, Kasta and eastern extension of the Raniganj coalfield were assessed.

12.17.1.3 Borehole cores from Karo, Chalkari, Govindpur, Sawang and Tulbul Blocks (West Bokaro) were analysed. Kargali, Bermo, Jarangdih, Kathara, Uchitdih and Karo groups of seams were identified in the former four blocks. They have been found to be generally strongly coking. The coal seams from Tulbul Blocks were found to contain Raniganj Measure coals, with the upper unidentified seams mostly non-coking. Of the borehole coals received from West Bokaro coalfield Pundi block coals were found to be strongly caking.

12.17.1.4 Investigation on borehole cores from prospecting blocks in Talcher, Chirimiri, Karanpura, Korba, Bisrampur, Jhilimili, Lakhanpur, Sohagpur and Ib River coalfields and two borehole samples from the Directorate of Mines, Orissa, were undertaken. North Karanpura coals (Badam and Ronhe areas) were found to be semicaking but inferior in quality (ash 26%).

12.17.1.5 Assessment of quality of coals from working collieries (South Balanda, Talcher and Deulbera) in the Talcher coalfield revealed that they are of good quality (ash 16%).

12.17.1.6 Coals in Sohagpur coalfield in the Batura Block and Majhem area have been found to be non-caking to semicaking, those from Kharagaon and Songara areas of Bisrampur coalfield to be non-caking and those from Lakhanpur (a virgin area) to be non-caking, subhydrous and low in volatiles.

12.17.1.7 Samples were collected for quality survey from No. 1 Incline (Seam No.3) Ramagundam, of the Godavari coalfield and from Kalichapar colliery (Seam No. 1) in the Pench and Kanhan valley coalfield. Samples were also collected from seam No. 4 (Nos. 1, 1A, 2&5 Inclines) for washability tests. Borehole coal cores received from the exploratory drillings in the Godavari Valley, Wardha Valley, Warora, Banda, Pench and Kanhan Valley coalfields were analysed for quality assessment.

12.17.1.8 Physical and chemical survey on coals from Namdang, Tipong, Ledo and Baragolai collieries, Makum coalfield, Assam, and from Nazira colliery, Nagaland was continued. It was found that (i) Makum coals are strongly caking coals containing low ash and sulphur ranges from 1-5 per cent and (ii) Nazira coal is weakly caking with low ash (4-6%) and high sulphur (around 6%). Coal and oil samples from the oilwells of Rudrasagar and Lakwa were analysed for study on metamorphism with depth.

12.17.1.9 Channel overall samples were drawn from Mandi district (Himachal Pradesh) and a number of samples from Metka, Kalakot (Bergoa & Tatapani Blocks), Jangalgali and Mahagola coalfields in Jammu. Washability float and sink tests were conducted on borehole sludge samples obtained during drilling by the Geological Survey of India in Metka, Jain

12.17.1.10 Most of the sludge samples were screened and different size fractions subjected to different tests for quality assessment.

12.17.1.11 Borehole cores received from N. C. D. C. drilled in West Bokaro (Pundi Block) V-VII seams, Ramgarh (Block II, VII seam) and East Bokaro (Karo Block) Coalfields, were lithologically studied and logged. Many coal samples were drawn from Jharia Coalfield for private parties for the purpose of quality assessment.

12.17.1.12 About 50 samples of coal, largely medium volatile coking type, were petrographically analysed and the maceral composition correlated with the results of laboratory carbonization tests. Petrographic and reflectance studies on the natural coke (Jhama) in relation to normal unaffected coals have indicated that partial graphitization has taken place in Jhama and the natural coke formation might have taken place above 400°C. Some of the coals studied petrographically include Ramgarh VII seam, Dugda I & II coals, Zero seam (Bastacolla Colliery), Rakhikole, Kalichapar & Daniya (Maharashtra) Coals, Sanctoria (Raniganj) and Monidih (Shaft II, XVII A seam) coals. More than 100 pellets were prepared from these coals. Results of analyses of various coal seams of South Karanpura Coalfield were compiled for the Coal Assessment Committee.

12.17.1.13 A number of geological maps were prepared including iso-ash maps for Sudamdih Block.

12.17.1.14 A study of the comparative merits of ISI and ISO methods of coal sampling revealed no marked difference between the standard deviations.

12.17.1.15 Based on statistical analysis, it has been found that the weights of representative gross samples of coke required for sampling would be much less than prescribed in the tentative I. S. specifications.

12.17.1.16 Studies on the determination of Hardgrove Grindability Index (H. G. I.) for different coal samples middlings, rejects and their blends including different size fractions, were performed with the object of improving the pulverizing properties (as measured by H. G. I.) by blending or by treatment with some cheap reagents. Low values of H. G. I. indicate that less energy is required to produce more in 'new surfaces' facilitating pulverization. The results of grindability tests during the past 10-12 years have been compiled. Statistical relationship between H. G. I. of coal and actual performance of pulverizers has been determined. It has been found that H. G. I. is always in the range of 60-85 for coking coals of Jharia coalfield (seam I-XVIII) and the range of H. G. I. is as a rule between 40 and 65 for caking but non-coking coals.

12.17.1.17 A survey was carried out on the rate of consumption of domestic fuels, e.g. softcoke, dungcake, firewood and kerosene and electricity per household per month in a modern residential estate. A draft project report on a plan for popularization of coal and coke in rural areas has been prepared with a view to replacing cowdung and wood for use as domestic fuel.

12.17.1.18 Requirement and availability of washery byproduct fuels or of raw coals for a proposed 1000 MW Power Station at Santaldih, West Bengal, have been assessed. It has been found that about 3 million tonnes

12.17.1.19 A study was made on the measurement of productivity of labour and capital in industries including coal mines and power stations with a view to indicating means of achieving higher output with the existing men, material, equipment and capital.

12.17.1.20 Investigations on the washability of coals for the various washery projects were continued. Based on the results of washability studies on coals, a feasibility report, in three parts, was prepared for the proposed washery at Sudamdih, Jharia Coalfield and submitted to the National Coal Development Corporation authorities.

12.17.1.21 For the Monidih Washery Project of the NCDC, samples received from Nos. I & II shaft working XVII A seam coal of Jharia Coalfield were investigated for washability characteristics.

12.17.1.22 At the request of *Hindustan Steel Ltd* (HSL) and *Roberts Schaefer Ltd*, contractor for the Pathardih Washery, acceptance tests of the HSL washery at Pathardih were carried out with the samples drawn from the raw coal section and also from two heavy medium baths and two jigs of the washing section of Pathardih Washery. The efficiencies of different equipments comprising various units were evaluated and comparison made against their guaranteed values. Performance study of another HSL Washery at Bhojudih was undertaken and investigations completed. Suggestions have been made for further improving the efficiency of the washery.

12.17.1.23 About 100 tonnes each of a blend comprising coals from four different collieries which are expected to supply raw coals to Dugda II washery and of another coal sample from Rakhikole Colliery (Kanhan Valley Coalfield) were tested in the 40 tonnes/hr Pilot Washery at the Institute.

12.17.1.24 Washability tests were carried on a 2-ton sample of coal from Hurriladih XI seam (ash 22 per cent) for *Macneil & Barry Ltd* and about 81 per cent cleans (16-17 per cent ash) and 18 per cent middlings (about 32 per cent ash) could be recovered.

12.17.1.25 In order to supply design data to the Russian experts, data on calorific value, ash fushion, ash analysis, etc. of washed coals that will be produced at the Kathara Washery were required by the Bokaro Steel Project. About 12 tonnes of sample were collected from the Kargali top seam and washed employing different washing units. The ultimate yield of middlings was about 11 per cent with 34 per cent ash and of cleans (13.5 per cent ash) was about 83 per cent.

12.17.1.26 Float and sink tests were conducted on different size ranges of coal samples from XV seam (Pure Chasnalla Colliery). The optimum weight of a sample with respect to a particular size is indicated to be less than that prescribed in the draft Indian Standards Specification.

12.17.1.27 Effectiveness of a blend of diesel oil (220-300°C.) and L.T.C. tar fraction (270-330°C.) as collecting agent in flotation cell was studied on Dugda slurry and slurries from Pundi VII seam coal. The blend containing 66.7 per cent diesel oil and 33.3 per cent tar oil fraction was found to give best flotation efficiency. The results can be further improved by the use of double grids in sub-aeration cell.

different types of classifiers, e.g. the centrifugal type and the air-elutriation type and their efficiencies of separation determined.

12.17.1.29 From the large number of tests carried out on the dewatering of slurries from Bhojudih and Patherdih washeries, it was evident that moisture of the wet fine coal could be reduced to about 39 per cent by screening (using high speed screen) and by treating the unrecovered slurry in properly designed screen having a finer aperture for the deck.

12.17.1.30 Metallurgical coke of satisfactory quality was obtained with top charging in 400 mm. pilot ovens from blends containing 10 per cent Churcha coal (M.P.) and 80 per cent washed coal from Dugda I and Kargali (1 :1) with conventional crushing. Almost similar results were obtained with 15 per cent Churcha coal in the blend. There was a remarkable improvement in coke quality when in the above blend proportion Churcha coal was increased to 25 per cent and stamp charged. The tests in the pilot plants have shown that with correct preparation and blending, which also includes correct degree of crushing (100 per cent through 3 mm.), 10-16 per cent Churcha coal can be used in coking blends of Bhilai for the production of metallurgical coke.

12.17.1.31 Pilot plant coking tests were carried out for the Ramgarh Industrial Complex of NCDC which envisages a carbonization capacity of 4000 tons of coal a day. The results showed that carbonization of straight washed Ramgarh coal produced substandard coke and about 30 per cent low volatile washed Jharia coal should be blended with washed Ramgarh coal in order to produce satisfactory coke. Also, size of coke in both the above cases improved with addition of about 3 per cent of finely crushed coke breeze, but resulted in the slight increase of abradability of the resultant coke. The optimum temperature of carbonization was found to be 1200°C. with about 20-21 hr carbonizing time. It was also found that small quantities of finely crushed coke breeze could also be added to the 70-30 binary blend of washed Ramgarh and washed Dugda II type coals for producing excellent blocky coke, suitable for foundry purposes, provided stamped charging was adopted.

12.17.1.32 Binary blend of washed Ramgarh and washed Dugda II coals (70 :30) was also tested in the TISCO ovens (C.B.C.R.) at Jamshedpur.

12.17.1.33 Investigations on the blending potentiality of Sanctoria seam coal in replacement of Dishergarh seam coal in ternary blends, now in use in Durgapur area, have revealed that the former coal from Seetalpur/Ranipur Collieries (Raniganj Coalfield) could be used up to 30 per cent in blends containing 45 to 50 per cent washed Patherdih and Dugda I coals (in equal proportions) and the rest Laikdih seam coal from the Raniganj coalfield.

12.17.1.34 Pilot plant coking tests with Kanhan Valley coals (Damua, Kalichappar and Rakhikole) were conducted for finding out suitable blends of these coals with the prime coking coal of Jharia for use in the pig-iron plant of 1200-1400 tonnes per day capacity in the Chanda District of Maharashtra. Straight Kanhan Valley coals failed to produce good metallurgical coke. But it was found that strong metallurgical coke could be produced even without blending with prime coking coal (Jharia) from the ternary blend of these coals by top charging at low moisture level (3 per cent Gross Moist.) or by stamped charging at high moisture levels (9.5

Valley coals can be used as a medium volatile group of coals in a blend with high volatile weakly caking Raniganj coals and low volatile Jharia coals.

12.17.1.35 The operational difficulties experienced at Durgapur Coke Oven were investigated by analysing coke samples and remedial measures embodied in a special investigational report have been submitted to the authorities of the Durgapur Coke Ovens.

12.17.1.36 Coke of satisfactory quality was produced from Mudidih X seam coal by performing Box coking tests. Satisfactory metallurgical coke was obtained from clean coals from two shafts in Monidih Block I working XVII seam by carbonizing in tin boxes.

12.17.1.37 Tests were conducted with Bhojudih Washery cleans in the 400 mm. & 450 mm. wide ovens to find out the effects of oven width on the coke quality. The coke from the wider oven yielded blockier coke.

12.17.1.38 A ternary blend comprising 45 per cent XI, XII, XIII seam coals (Bararee), 35 per cent Laikdih and 20 per cent Dishergarh seam coals of the Raniganj coalfield, was carbonized at different flue temperatures and the cokes produced below 1260°C. were more abradable in nature.

12.17.1.39 Full scale medium temperature carbonization tests at 6 tonnes throughput per retort per day was conducted with Kenda (Raniganj coalfield) coal and the properties of the semicoke produced and the byproduct obtained were determined. Tests with Lower Kenda coal (old stock) were continued. Several samples of retort gas supplied to the burners of the L.T.C. plant as well as flue gas were analysed for process control studies. A full scale test on Rana seam, Sripur Colliery, Raniganj coalfield, under medium temperature (1010°C. at the top and 870°C. at the bottom of the retort) carbonization with an average coal throughput of 8 tonnes per retort per day was conducted to assess the suitability of semi-coke produced for domestic and industrial purposes. In all, about 3500 tonnes of coal were carbonized which yielded roughly 2,200 tonnes of semi-coke and 54,000 gallons of tar.

12.17.1.40 Coke suitable for domestic use was obtained from non-coking, low volatile Bhomori coal and coking coal (Hijuli seam) from Perbelia (Raniganj) when carbonized in stoker carbonizer.

12.17.1.41 Considerable work, both on fundamental and applied aspects, was done on the production of briquettes from non-coking coals for metallurgical use. It was inferred that (i) hard, shaped, tailor-made metallurgical fuels, could be prepared from non-coking coals, including lignites, in intergrated plants; (ii) chars from non-coking coals and/or lignite could be briquetted with the tar obtained from carbonization of these coals/lignites, after processing and then the briquettes after catalytic heat-treatment could give coke of satisfactory strength for industrial use. Successful foundry trials with these briquettes were carried out in an experimental cupola at CFRI. Attempts have also been made to incorporate fluxing agents, viz. limestone, etc.

12.17.1.42 Fluxing of the raw materials used for the preparation of briquette-coke (Brico) was studied with 'Leco' fines (Neyveli), semi-coke fines from Talcher and Singareni coals. Ash fushion test of the ash from 'Leco' fines showed that the initial deformation temperature was 1240°C

different amounts of limestone (15 to 25 per cent) were ashed and subjected to ash fushion tests.

12.17.1.43 Moderately strong briquettes (2.5 in. diam. and 2 to 3 in. long) could be formed from a cool blend containing 60 per cent Singareni fines through 200 mesh) and 40 per cent Samla fines (through 1/16 in.) with 10 per cent moisture content by high pressure briquetting.

12.17.1.44 Characterization of tar and middle oil samples from Neyveli Lignite Project Ltd was continued. The middle oil was rich in low boiling tar acids and was different from usual L.T. tar in many ways. Neutral oils (73 per cent) distil over in the kerosene range.

12.17.1.45 Improvement in the quality of pitch from L.T. tar could be effected by incorporating L.T. coke powder in the pitch to make the Conradson carbon 45 per cent w/w (minimum) and maintaining the softening point between the specified range of 98-103°C.

12.17.1.46 Experiments on the study of extraction of benzene by neutral oil (South Balanda) fractions, rich in aromatics, have been completed.

12.17.1.47 Infrared spectral studies on four Assam coals were carried out by the KBr pellet technique in the new Perkin Elmer Model 421 spectrophotometer. Infrared absorption spectra were also recorded for a mature coal from the Raniganj area and lignite sample from South Arcot (Madras State) for comparison. A morpholine extract of coal was prepared and the spectrum recorded by both KBr pellet method and also as thin film on a single rock salt window. Spectral features were determined and their characteristics are to be correlated with the high sulphur content and volatile matter of the Assam coals.

12.17.1.48 Precise distillation of L.T. tar was carried out in the Podbielniak Minical instrument and the different fractions were analysed by vapour phase chromatography and infrared spectrophotometer. It has been estimated that 0.3 per cent mesitylene is present.

12.17.1.49 Studies were made on the dealkylation of motor benzole (boiling above 110°C.) obtained from Sindri, at different reaction temperatures and contact time to see whether the losses due to coke formation could be minimized. Experiments were continued on the dealkylation of alkylnaphthalenes (boiling up to 227°C.) of H.T.C. tar fraction from Durgapur by use of cobalt molybdate on alumina as catalyst.

12.17.1.50 Production of jet fuels from L.T.C. tar fractions (270-300°C.) by using $MoS_3$ catalyst has shown promise.

12.17.1.51 Light aromatic extract from Noonmati Refinery (Iomex) and a fraction (170-300°C.) of Nahorkatiya crude were charged into a continuous flow vapour-phase reactor and limiting conditions of temperature, pressure and catalyst-activity were determined in order to obtain a maximum possible throughput of kerosene with 20 mm. (minimum) smoke point.

12.17.1.52 Water gas, purified for its sulphur content, was synthesized at 300°C. under the influence of a nitrided catalyst under pressure (100 psig). Mainly oxygenated product with traces of oil layer was obtained. The yield of liquid product was about 52 g./$Nm^3$ of $CO+H_2$ and CO conversion was around 65 per cent.

produce synthetic petroleum. Maximum conversion obtained was 92.2 per cent and the average yield of liquid products was about 79 g. per 100 g. of coal. L.T. neutral oil (230-270°C. and 270-300°C.) fractions were used as vehicle for the hydrogenation tests. The oils were distilled to get 10° fractions (up to 180°C. and then 180-190°C., 190-200°C. and so on and finally above 300°C. fraction) and densities and refractive indices of various fractions were determined.

12.17.1.54 Singrauli coal crushed to 90 per cent through 200 mesh B.S.S. and containing moisture around 5.5 per cent was gasified in the powdered coal gasification plant. A raw gas containing 85 per cent of $(CO+H_2)$ of calorific value of about 2650 kcal./$Nm^3$ was produced.

12.17.1.55 Two series of tests were conducted to study the gasification characteristics of Dobrana coal from Raniganj coalfield and Burhar coal from M.P. coalfield in the pressure gasification plant. Pressure employed was from 10 to 21.1 kg./cm. and the coal (6-25 mm.) feed rate was varied from 284 to 366 kg./hr for the Dobrana coal and from 352 to 487 kg./hr for the Burhar coal. Methane content of the gas produced was more with increase in pressure of gasification and at the maximum pressure employed, 11-12 per cent methane was obtained. The calorific value of the purified gas (containing 2% $CO_2$) was of the order of 4000 kcal./$Nm^3$.

12.17.1.56 Series of experiments were carried out on methanation of producer gas with a catalyst comprising nickel, aluminum and kaolin kept at 300°C. From 2.4 per cent methane in the feed gas ($CO : H_2 : 1 : 4.5$), 53.2 per cent methane was obtained in the producer gas.

12.17.1.57 Removal of organic sulphur from industrial gases was tried with CFRI-produced active carbon from Samla coal and lignite. With $CS_2$ vapour being carried over the catalyst by purified gas from powdered coal gasification plant, the adsorption capacity of activated Samla coal was observed to be 0.3 per cent by weight while the same for activated lignite was 0.2 per cent by weight. When L.T.C. gas was used as the carrying medium for $CS_2$ vapour with an inlet concentration of organic sulphur around 30.9 g./100 $m^3$. of gas the adsorption capacity of the activated Samla coal was 0.05 per cent by weight.

12.17.1.58 Catalytic reforming of gases was tried with Al, Ni, Cr and Zn at about 780°C. and the concentration of methane in the feed gas could be reduced from 30 to 13 per cent. Tests were performed with 8 in. cyclone separator for studying its efficiencies for the dedusting of gases.

12.17.1.59 The feasibility report prepared by the Institute for the phased development programme of utilization of Ramgarh coals has been accepted by NCDC and the Ministry of Mines and Metals. Based on this, *Hindustan Steel Ltd* prepared a feasibility report for setting up of a coke oven for carbonizing 4000 tons of coal per day with byproduct recovery. To help prepare a final project report, tests were conducted in pilot plant scale with Ramgarh coals in respect of preparation, blending and carbonization conditions and detailed report was prepared.

12.17.1.60 At the request of the Government of India the scheme of Talcher Industrial Complex submitted earlier from the Institute was reassessed. A two-stage development scheme has now been suggested. In the first stage, carbonization capacity will be only for 400 tonnes of coal

for a total of 600 tonnes/day) and the pig-iron production will be 130 tonnes per day. The revised scheme also suggests utilization of coke-fines via briquetting as shaped metallurgical fuels to be subsequently charged into the pig iron plant.

12.17.1.61 At the instance of the Ministry of Mines & Metals, a note was prepared showing a pattern of coal based industrial development of India. In this scheme the country has been divided into seven zones taking into consideration coals of more or less similar quality from different coalfields and grouping them together conveniently depending on the proximity of their occurrence.

12.17.1.62 Potentialities of converting coal to oil synthetically in the country have been reviewed in a note prepared during the year. Assam coals have been found to have great promise for conversion to synthetic petroleum.

**12.17.2 RRL Hyd.** — Work on production of metallurgical coke from low-grade coals has shown encouraging results in the laboratory-scale experiments. A pilot maturing unit for briquettes with a capacity of about 200 kg. per day, designed and fabricated in the Laboratory, is in continuous operation producing domestic coke.

12.17.2.1 The Laboratory has prepared the following reports: plant for low-temperature carbonization of coal for the *Singareni Collieries Co. Ltd*, Kothagudem with an ultimate capacity of 2700 tonnes of coal per day in three phases of 900 tonnes each; a feasibility report on low-temperature carbonization of Maharashtra coals (on behalf of the Government of Maharashtra).

**12.17.3 IIP** — The crudes of Ankleswar, Kathana and Kalol (Gujarat), Nahorkatiya (Assam) and Lakwa (Sibsagar region) have been completely evaluated for their characteristics with the object of working out process know-how, plant design, economics of producing specific products and petrochemicals from them.

12.17.3.1 Performance rating of lubricating oils are usually made using foreign engines, such as caterpillar and Petter AV1 engines. Investigations were undertaken to develop and standardize Kirloskar AV1 engine, on indigenous engine, using reference oils under Indian conditions so that the results can be correlated with the performance of foreign engines. The investigations have shown that the indigenous engine can be used for getting repeatable results and that it is possible to fix accurately the ratings for differentiating MIL-L-2104A oils or ISI HD oils from others. The method has been suggested for inclusion in the ISI standard for Motor oils HD type.

12.17.3.2 Based on its pilot plant studies, the Institute has prepared process design books for commercial plants for reclamation of used lubricating oils. Formulations have been developed for treatment of reclaimed oils with additives. The finished products have been assessed for performance by engine tests.

12.17.3.3 Similarly tests on engine fuels have been standardized so that any user can check whether its engines and operating conditions are in line with the normal standards. The octane rating of gasoline produced

12.17.3.4 A cold chamber has been installed to test the performance of engines of defence vehicles operating at high altitudes, high wind velocities and low atmospheric pressure.

12.17.3.5 The problem of overcoming shortage of kerosene in the country has been studied from three approaches: (i) improvement of design of domestic lamps so that inferior kerosene can be used satisfactorily; (ii) improving the quality of inferior kerosene by hydrogenation; and (iii) study of possibilities of producing kerosene from residual fractions by hydrocracking and other techniques. In regard to the first approach, a simple device costing a few paise has been evolved by which chimneyless solid cylindrical wick lamps can burn inferior kerosene and produce 0.65 candles luminosity as compared to 0.7 for superior kerosene. A proper design of the burner of flat wick table lamps has been developed by which they can use kerosene to produce 13.4 candles. The burner design of hurricane lamps for producing 6.0 candles using kerosene has also been developed.

12.17.3.6 A formulation based on castor oil, high molecular weight alcohol and other ingredients has been made for producing hydraulic brake fluid which is at present imported. A process has been developed for producing from wool grease superfine grade of anhydrous lanolin used in manufacture of metal lubricants, cosmetics, pharmaceuticals, lube oil additives, etc. The process, which is simple and inexpensive, gives lanolin better than superfine grease.

12.17.3.7 Catalyst needed for petro-refining and petrochemical operations are imported. In the course of investigations for their indigenous development, two catalysts, special grades of silica gel and tungsten sulphide-nickel sulphide on alumina have been evolved. The silica gel catalyst has been found to be suitable for FIA method of hydrocarbon type analysis and to be comparable to imported standard Davison silica gel grade-923. The other catalyst has given results comparable with imported ones for hydrogenation of inferior Nahorkatiya kerosene and subsequent sulphidation *in situ*.

12.17.3.8 Investigations on naphtha as raw material for production of synthesis gas and town gas have given encouraging results. A complete gasification unit incorporating a hydrodesulphurization (HDS) unit for pretreatment of naphtha has been designed. A pilot plant for production of town gas is under fabrication using indigenous know-how.

12.17.3.9 An economic process has been developed for thermal reforming of aromatic extracts from kerosene extraction units for production of pure and simple aromatics. The process has won an award of the Inventions Promotions Board.

12.17.3.10 Work has been initiated on the following projects: formulation of detergent additives for motor oils; quality of aviation turbine fuel which deteriorates on storage because of formation of micro-organisms and which consequently caused damage to silver parts of one of the Caravelle jet craft involving it in an accident recently; improvement of quality of indigenous inferior kerosene by hydrogenation; study of possibilities of producing kerosene from residual fractions of Indian oil refineries by hyrocracking and other techniques; synthesis of protein via micro-organisms found growing in gas oil fraction from the Ankleswar crude and glucose.

Indian Oil Corporation, public sector refineries, Defence Department, Ministries concerned with petroleum products utilization and petrochemicals and private industries. The actual needs of the petroleum refineries and consumers, standardization of quality of products and possibilities of exploitation of indigenously available resources, equipment and process know-how are covered under these surveys.

12.17.3.12 The techno-economics of location of one or more refineries in South India have been studied on behalf of the Oil & Natural Gas Commission and recommendations were made for locating few refineries in South India, one at Cochin and the other at Madras, and for development side by side of fertilizer and petrochemical industries. This has saved the Commission consultancy charges to the tune of nearly Rs 5 lakhs. The entire work of selection of process production pattern process design for the Madras refinery was completed. Similarly the factors of governing the establishment of a refinery in Haldia (West Bengal) including site selection, market survey, product pattern and process study have been thoroughly gone into and suitable recommendations have been made.

12.17.3.13 The proper timing of expansion of the Bombay refineries taking into consideration market for particular types of petroleum products has been studied so that infructuous expenditure through inopportune refinery expansion can be avoided. Through this study foreign consultancy charges of more than Rs 2.5 lakhs have been saved.

12.17.3.14 Feasibility studies of (i) using Nahorkatiya naphtha as raw material for production of petrochemicals and aromatics; (ii) manufacturing transformer oils in Koyali, Madras, Cochin and Barauni refineries; (iii) producing aviation gasoline in the refineries, and (iv) manufacturing petroleum jelly indigenously.

12.17.3.15 Demand forecasts of petroleum products in India have been made so that they can be the basic data for planning of future refineries in the Fourth Plan. Survey and demand estimates have been made of major thermoplastics, rubber, insecticides and pesticides and of feed stock available for petrochemicals production. Demand estimates by the end of the Fourth Plan of hydrogen cyanide, chlorinated hydrocarbons have also been made. These have been carried out at the instance of the Gujarat petrochemical complex.

12.17.3.16 Design problems relating to catalytic reforming plant for boosting of motor gasoline to high octane number, process data books and design procedures for catalytic reforming, hydrocracking, hydrodesulphurization, bis-breaking, thermal breaking Iomex and reclamation of used lubricating oils, complete process design for propylene recovery from Barauni coker gas for making acrylonitrile fibres are the important activities in respect to design work.

12.17.3.17 A detailed survey on indigenous availability of equipment for the refineries and petrochemical complexes and on fabricating facilities in the country has been made and the information compiled and issued as a printed edition.

12.17.3.18 Economics of production of chemicals such as ammonia, sulphuric acid have been studied. Cost comparison for the manufacture of

## 12.18 Food Technology

**12.18.1 CFTRI —** Non-toxic insecticides based on vitamins, minerals and sugar have been developed for protecting cereals and protective foods from insect pests. These formulations can also be used against crop pests.

12.18.1.1 Ethylene dibromide absorbed on cellulosic material (disclets) and packed in polycel-aluminium foil laminates has been found suitable for fumigating grains in houses, farm stores, etc. These disclets are being produced at the Institute for extension programmes.

12.18.1.2 Conditions have been standardized whereby parboiled paddy can be dried even at very high temperatures (80°C.) without any damage to the grain. The method essentially consists of two-stage drying with an intermediate period of rest (tempering) followed by storing the paddy hot for 2 hr after the final drying. Dried in this way, parboiled paddy will give virtually no breakage during milling and will result in maximum out-turn.

12.18.1.3 To stabilize rice bran before processing for edible oil, a method involving its steam/heat treatment has been developed. Stabilization arrests development of rancidity in rice bran (due to lipase activity) after separation from grain.

12.18.1.4 A simple procedure has been worked out for detoxification of groundnut cake. This is an oxidation reaction which not only destroys aflatoxin, but also removes nutty odour and improves the colour of the meal.

12.18.1.5 Experimental production of toned milk based on a mixture of animal milk and reconstituted vegetable milk from groundnut protein isolate has been started in Bangalore Dairy. Feeding trials on school children are in progress. The product offers a solution to meet the shortage of fluid milk in the country.

12.18.1.6 A blend of groundnut flour, Bengal gram flour and sesame flour (2 :1 :1) fortified with vitamins and minerals has been developed. It has been found effective in treating protein malnutrition and for supplementing the diet of industrial workers, school children and expectant and nursing mothers.

12.18.1.7 Guar bean meal, a by-product of guar gum industry, is a potential source of protein for food and feeds. It has not been employed for cattle feeding, because of some anti-growth/toxic factors. It has been shown that by optimal heat processing, the nutritive value of the meal can be improved.

12.18.1.8 It has been found that the storage life of fresh tomatoes could be extended from 47 days to 80 days, when they were irradiated with 80 Krads of Cobalt-60 gamma rays at the respiratory pre-climacteric minimum followed by treatment with indolyl-3-acetic acid. A successful control of incipient fungus infection on *Alphonso* mangoes has been achieved by pre-harvest spraying with CAPTAN fungicide. A shock treatment with hot water at 53°C. has induced uniform ripening in mangoes.

12.18.1.9 Work has been undertaken to use pineapple and cashew wastes available in plenty in Kerala after suitable processing as cattle feeds. The feeding trials on sheep have shown great promise.

12.18.1.10 Processes have been worked out for the manufacture of white

The method of preservation of green colour in cardamom has been demonstrated before planters and exporters. These results will help in the export promotion of these important products.

12.18.1.11 Conditions have been standardized for the production and storage of pectic enzymes from moulds. The enzymes can be effectively applied in the recovery of juices from pulpy fruits like guava and banana and in the clarification of grape juice. Conditions have also been standardized for the production of liquid diastase concentrate.

12.18.1.12 A process has been worked out to prepare sausages containing meat, vegetable and cereal/pulse proteins with proper spicing to suit the palate of the consumer. In this process excess of lysine present in meat proteins has been used for supplementing vegetable proteins which are generally deficient in this amino acid.

12.18.1.13 A process for manufacture of silk worm pupae meal has been developed. Commercial exploitation of this process will help the States, like Assam, Manipur, Tripura, etc. for substituting fish meal for animal feed.

12.18.1.14 Preliminary studies on extending the shelf-life of cashewnuts for export purposes by using a suitable packaging medium consisting of aluminium foil laminate has given encouraging results and confirmatory tests are in progress. This problem was being carried out at the instance of *Hindustan Cashew Products Ltd*, Bombay.

12.18.1.15 Investigations on clinical proteincalorie malnutrition have indicated a deficiency in the capacity to hydroxylate phenylalanine to form tyrosine and reduction of excretion of acylphenylalanine. The presence of acylamino acid in normal human serum has been demonstrated. The significance of this finding in relation to protein synthesis and other reactions is under study.

12.18.1.16 Further observations have confirmed the beneficial influence of dietary protein supplements (30 g. calcium caseinate) on the glucose tolerance and insulin requirements of diabetic cases of the adult onset type. In a number of diabetic subjects of similar type, a significant hypoglycemic (blood sugar lowering) reaction to oral feeding of protein was noticed strongly suggesting the possibility of insulin secretion in response to the protein fed.

## 12.19 Glass, Ceramics and Insulating Materials

**12.19.1 CGCRI —** Production of optical glass was stepped up to keep pace with the increasing demand both from the Defence Organizations and the civilian users. About 3.6 lakhs moulded lens and prism blanks and 2.3 tons of slabs, worth about Rs 4.76 lakhs were produced. The production of periscope prisms for use in armoured tanks, taken up about a year ago, was also stepped up.

12.19.1.1 Production of radiation shielding windows for the Atomic Energy Establishment and other users was continued. Equipment and furnaces for making large windows of more than one square metre surface area were designed and fabricated.

12.19.1.2 Glasses having special absorption characteristics for use in locating and firing devices, night patrolli[illegible]

12.19.1.3 The entire requirement of quartz for use in electronic instruments is at present met by import. A few quartz crystals grown at the Institute by the hydrothermal technique were tested at the *Bharat Electronics Ltd* and were declared satisfactory. Developmental work for growing larger crystals of about 9 cm. × 4 cm. × 2 cm. size has been taken up.

12.19.1.4 Special enamel compositions for exhaust systems of jet engines to protect against high temperature corrosion, oxidation and chemical action of exhaust gases, developed earlier were subjected to trial under service conditions at the Gas Turbine Research Establishment, Ministry of Defence, Bangalore with promising results. The enamels are now being produced at the Institute.

12.19.1.5 At the instance of the Gas Turbine Research Establishment, Ministry of Defence, special enamel compositions for aircraft parts were worked out.

12.19.1.6 A process for the manufacture of grinding wheels for sharpening safety razor blades has been developed. Factory trials of the wheels made gave satisfactory results. The process was leased out to a razor blade manufacturing firm which has since gone into production of these wheels. The estimated saving in foreign exchange by one firm alone would be about Rs 3 lakhs annually.

12.19.1.7 High alumina bricks used in soaking pits of steel furnaces and in other industrial furnaces are entirely imported. There is a large demand for such bricks in the country. Refractories containing 75 to 95 per cent $Al_2O_3$ have been developed. They have been found to be comparable in quality to the imported products. Samples were sent for actual factory trials and further investigations on the basis of the results obtained are in progress.

12.19.1.8 Kiln furniture of high alumina compositions, developed at the Institute for special use, appeared to be promising. Further developmental work is in progress.

12.19.1.9 Opacifiers for potteryware made from indigenous zircon sands, developed earlier at the Institute to eliminate the use of imported tin oxide, were improved to give economy in production. The work was further extended to cover the low-temperature glazes. One big pottery firm, after actual trials in their factory on the opacifier developed at the Institute, highly appreciated the work and has made a monetary reward for this work.

12.19.1.10 In view of acute scarcity of lead oxide and borax in the country, lead-boron-free glazes were developed. These were tried out in a pottery factory with promising results. Further work is in progress. Adoption of these glazes would eliminate the use of imported lead and scarce borax in the glazing of earthenware.

12.19.1.11 Production on a semi-commercial scale of special items like glass electrodes for *p*H meters, special refractory tubes and shapes, sintered alumina products containing up to 98 per cent $Al_2O_3$, enamel stains and frits etc. was continued. Items worth Rs 1.41 lakhs were supplied during the period to the Defence establishments, *Hindustan Steel Ltd*, and research institutes.

12.19.1.12 Glass tank feeder refractories which are special refractories

items from USA, proved so successful that the firm rewarded the scientists with a sum of Rs 10,000.

12.19.1.13 Glass compositions, particularly for sealing with KOVAR alloy, were developed at the Institute and a few sample lots were supplied to the Atomic Energy Establishment which found them to be of satisfactory quality.

12.19.1.14 A process was developed for the production of heat insulating mica bricks having a low density (400 kg./cu.m.), high insulating efficiency and an average cold crushing strength (8 kg./sq.cm.) from waste mica as a suitable substitute for imported low density diatomite bricks.

## 12.20 Metallurgy

**12.20.1 NML —** Beneficiating and sintering studies of last two of the five iron ore samples from Dalli Mines referred to by *Hindustan Steel Ltd*, were completed. The two samples were of compact laminated and hydroxide variety. The laminated sample was of good grade with low insoluble contents of 3.94 per cent. It was possible to bring down the insolubles to 2.41 per cent in the 1/2 in. fraction by wet screening the ore after crushing to about 2 in. size. About 23 per cent of the silica and 14 per cent of the alumina in the sample could be rejected in the slime with an iron loss of only 1 per cent. The 1/2 in. washed fines after desliming could be sintered without needing any further beneficiation. Good metallurgical quality self-fluxing sinters having basicity ratios $(CaO+MgO/SiO_2+Al_2O_3)$ up to 2.4 could be produced.

12.20.1.1 The hydroxide sample was of low grade containing 18.9 per cent insolubles. It was possible to bring down the insolubles to 4.66 per cent in the 1/2 in. fraction by washing and upgrading the ore after crushing to about 2 in. size. The 1/2 in. washed fines after jigging yielded a product assaying Fe, 53.7 per cent and silica + alumina 11.3 per cent. Fluxed sinters of basicity ratio $(CaO+MgO/SiO_2+Al_2O_3)$ up to 2.02 possessing good strength could be produced from the upgraded fines.

12.20.1.2 Similar studies were carried out on the iron ores from Meghataburu Mines for supply to the Bokaro Steel Plant. Results of pilot plant studies have indicated that washing could successfully solve the problem of handling sticky and wet ore to yield sized lumpy ore free from adhering fines for blast furnace charging and reject a slime high in alumina and silica. By employing jigging of the washed ore fines, the silica and alumina content of these could be further lowered.

12.20.1.3 Sintering characteristics of the −3/8 in. (−9.5 mm.) beneficiated fines were also studied in detail and the results indicated that good metallurgical grade fluxed sinter could be produced. Mixed firing technique employed for sintering showed that the solid fuel (cokes) could be substituted by a gaseous fuel namely, producer gas up to the extent of 30 per cent without appreciably affecting the sinter quality.

12.20.1.4 Pilot plant tests on beneficiation and sintering characteristics of a mixed sample of laminated iron ore from Rajhara mines of Bhilai Steel Plant, were undertaken at the instance of *Hindustan Steel Ltd.* Washing the ore after crushing to about 2 in. size followed by upgrading of fines yielded washed lumpy ore low in alumina and silica suitable for

12.20.1.5 Beneficiation studies on copper ores from three sources, Rakha and Kolihan and shaft No. 3 of Khetri were carried out on behalf of the National Mineral Development Corporation. The low grade copper ores from Rakha (Cu, 2.73; Ni, 0.072; Mo, 0.025; Co, 0.02; $SiO_2$, 73.08; Fe, 5.54; and S, 3.96 per cent) was found to contain chalcopyrite as the chief copper mineral. It was possible to liberate it from the siliceous gangue at about 100 mesh size. Roughing with K.E. xanthate and pine oil at *p*H 8.8, the float assayed 24.31 per cent of Cu and 96.9 per cent of Cu was recovered. Refloatation of rougher float on grinding to —150 mesh size yielded refloat copper concentrate assaying 30.1 per cent copper with a recovery of 91.0 per cent copper in it. Molybdenum concentrate assaying Mo, 35.9 per cent ($MoS_2$, 60.0 per cent) with 68.4 per cent recovery was obtained as valuable by-product.

12.20.1.6 Floatation studies were conducted on Kolihan copper ore assaying 2.96 per cent copper. The chief copper minerals were found to be chalcopyrite and pyrrhotite in almost equal proportions with minimum amounts of magnesite and pyrite. Principal non-metallic minerals were quartz and chlorite. Liberation of chalcopyrite occurred at about —150 mesh size. Floatation followed by one cleaning of rougher float yielded concentrate assaying 27.41 per cent Cu with copper recovery of 93.8 per cent and recovery of Au and Ag 96.8 and 47.7 per cent respectively.

12.20.1.7 Comprehensive laboratory scale floatation studies have been conducted on Khetri copper ore sample. The ore assaying Cu, 0.79 per cent contained abundance of magnetite, chalcopyrite, pyrrhotite and pyrite and traces of marcasite. Fair liberation of chalcopyrite occurred below 150 mesh. Roughing with K.E. xanthate and pine oil at neutral *p*H obtained maximum recovery of copper value. One, two and three cleanings of the rougher concentrate at *p*H range of 9.5-10.5 produced final concentrates assaying 7-15 per cent Cu with recoveries ranging from about 88-63 per cent. The bulk concentrate after refloatation assayed Cu, 12.28 per cent with a copper recovery of 90 per cent.

12.20.1.8 Low grade magnesium powder (120 kg.) was reconditioned. Manganese-magnesium powder (195 kg.) was also reconditioned to defence specification by a process evolved in the Laboratory. Both the products were supplied to ordnance factories. Electrolytic manganese metal (710 kg. and 500 kg.) was supplied to *Hindustan Aircraft Ltd*, and *Explosives Research & Development Organization*, Kirkee, respectively. About 1 ton of electrolytic manganese dioxide was produced and supplied to *Union Carbide Ltd* for making batteries for defence establishments. An order for supply of 5 metric tonnes of ferro-aluminium to *Metal and Steel Factory*, Ishapore, has been undertaken. During the year, 4,202 kg. were supplied.

12.20.1.9 Work on direct reduction of iron ore by light petroleum naphtha was conducted. The iron ores of all grades were directly reduced to metallic iron by this process employing suitable fluxes. It was observed that the reduction of the iron ore depended on the reduction time and rate of feeding petroleum naphtha at the optimum reduction temperature range. Complete reduction to metallic iron was observed to take place at 1050°C. Various reduction parameters were evaluated.

12.20.1.10 Pilot plant investigation of forsterite refractories from basic rock, utilizing two alternative processes for study of process variables has

powders were properly graded and blends of high packing densities were used and magnesite in such bodies, should preferably contain certain properties of light calcined magnesia. Fabrication pressure of the order of 10,000-14,000 lb./sq. in. was found to be optimum. The results also confirmed that on a large scale, the two-stage process originally developed for this work yielded good compacts of satisfactory properties.

12.20.1.11 Two grades of sodium salts of carboxymethyl cellulose under the trade name of 'Cellpro HV' and 'Cellpro LV' of high and low viscosities containing *c.* 50 per cent of sodium carboxymethyl cellulose (CMC) respectively received from *Imperial Chemical Industries (India) Pvt. Ltd* were studied for evaluating their suitability as core binders.

12.20.1.12 The following inferences were drawn from the studies: (i) Cellpro can be used for green, dry or baked cores; (ii) Cellpro as a sole binder should be added to the extent of 3-5 per cent in sand mixtures to obtain optimum strength and hardness in cores and to avoid friability of their surfaces; (iii) Cellpro HV imparts higher strength in the green state which Cellpro LV is superior in the baked state; (iv) Cellpro in the range of 0.5-1.5 per cent in conjunction with 1 per cent linseed oil with 4.0 per cent moisture develops baked properties superior to the conventional straight linseed oil bonded cores; (v) the volume of gas given off by the Cellpro binders is less than that evolved by linseed oil; and (vi) the casts with Cellpro bonded cores shows easy collapsibility and good shake out characteristics.

12.20.1.13 Investigations were conducted on the utilization of Dabok limestone (CaO, 54.8; $SiO_2$, 1.24; $Al_2O_3$; 1.22; MgO, 2.0 per cent and traces of S) for iron smelting in the low shaft furnace. The ore samples were studied for screen analysis, tumbler test, shatter index, abrasion tests, and dissociation characteristics. The results revealed that the limestone was entirely satisfactory for iron smelting. The Laboratory has also successfully produced pig-iron in low shaft furnace, employing low-temperature carbonized coke thus proving the possibility of establishing regional pig-iron plants.

12.20.1.14 The side-blown converter possesses the following advantages over the bottom-blown Bessemer process in making steel: (i) no 'after flow' or other refining treatment is required; (ii) both dephosphorization and desulphurization are of high order; (iii) it can be adopted in locations remote from supplies of tonnage oxygen or oil; (iv) it can use steel scrap with suitable adjustment when continuously operated; and (v) the capital and operational cost of the process is substantially lower than that for the conventional process. Hence, studies were made to produce steel using Indian basic pig-iron containing medium phosphorus in a 500-kg. experimental side-blown converter designed and fabricated in the Laboratory. The studies have proved the technical feasibility of the process as a possible competitor for L-D oxygen steel making.

12.20.1.15 At the instance of Indian Railways, the Laboratory has developed antifriction liner from bakelite and asbestos and has sent samples of 6 in. × 6 in. size to Indian Railways for service trials. The know-how of the process has since been intimated to the Research, Design and Standards Organization. Accelerated corrosion test on the hot-dip aluminized overhead traction equipment for Railway Electrification Project has been completed.

ness, the phenomenon of retrogression shown by precipitation hardening alloys has been investigated with a Ni-Cr steel known to be susceptible to temper brittleness. The displacement in transition temperature $\triangle T$ (temperature at which fracture ceases to be 100 per cent ductile) with increasing amount of temper embrittlement was used as the parameter to follow the course of embrittlement. The variation of $\triangle T$ with increasing time of embrittlement has been found to bear resemblance to hardness-time curve of precipitation hardenable alloys suggesting that the mechanism controlling temper brittleness is a process of nucleation and growth. Retrogression experiments carried out by embrittling at 400°C. followed by embrittlement at 500°C. also suggested that the controlling mechanism for temper brittleness would probably be nucleation and growth. While there was no difference in hardness between embrittled and unembrittled specimens, embrittled specimens showed intergranular fracture. Microscopic examination of specimens etched with aqueous picric acid showed preferential grain boundary attack, the grain boundary attack increasing with increasing amount of embrittlement.

12.20.1.17 Curie temperatures of iron-aluminum (0-30 atomic Al per cent) and iron-silicon alloys (0-25 atomic Si per cent) have been measured by an induction method. The variation of Curie temperatures with composition of these alloys suggests a process of electron absorption by iron at lower percentages of solute due to filling up of the holes in the 3*d* band of iron in excess of those that are responsible for ferro-magnetism. The process of filling up of these excess holes is at a rate proportional to the valency electrons contributed by solute. Addition of more solute, once these excess holes are filled up, reduces Curie temperature at a faster rate which is suggested to be due to the formation of structurally similar superlattices $Fe_3Al$ and $Fe_3Si$. Whilst reduction of Curie temperatures for iron-silicon alloys in this range suggests a phenomenon of dilution, for iron-aluminum alloys it is a case of dilution followed by a rapid decrease and this is attributed to differences in bonding and sizes of aluminium and silicon atoms in $Fe_3Al$ and $Fe_3Si$ superlattices.

12.20.1.18 Examination of some of the existing data on these alloys on the basis of these concepts has revealed the following: (i) occurrence of superlattice structures $Fe_3Al$ and $Fe_3Si$ in these alloys is accounted for on the basis of the above concepts and the bonding consideration put forward by Altmann, Coulson and Hume-Rothery; (ii) these structures appear to resemble electron compounds. Atomic radii data of $Fe_3Al$ and $Fe_3Si$, lattice spacings of these alloys and the steep rise in coefficient of thermal expansion associated with the formation of $Fe_3Al$ suggest that in $Fe_3Al$, the Fe-Al bond is metallic whilst in $Fe_3Si$ the Fe-Si bond is covalent; (iii) besides accounting for the variation of electronic specific heat of these alloys on the basis of these concepts, the decrease in coefficient of thermal expansion of iron-aluminum alloys in the range 0-12 atomic Al is reconciled with the increase in electronic specific heat in the same range; and (iv) the kinks in lattice spacing composition curve of these alloys suggest that whilst formation of $Fe_3Si$ is smooth, the formation of $Fe_3Al$ causes fluctuations in lattice parameter which are related to the entry of solute electrons in the 3*d* band of iron.

12.20.1.19 Properties of ternary Cu-Mn-Zn and Cu-Mn-Ni have been investigated in order to examine their suitability for commercial exploitation in India. The alloys investigated contained Cu, 80-65; Mn, 8-25; Zn, 8-25;

increasing the ductility and deep drawing properties of the alloy though there was some decrease in strength and hardness. On the other hand addition of nickel increased the strength and hardness and had no marked effect on ductility and deep drawing properties. Addition of zinc and nickel was found to increase corrosion resistance properties of Cu-Mn alloys. Some of the alloys were also investigated for their susceptibility to stress corrosion cracking and were found to possess good resistance to cracking.

12.20.1.20 Study of slags for their utility as slag cement with the help of mathematical programming was completed. A model has been developed for determining the maximum permissible limits of MgO and MnO contents in the slag as well as its utility as slag cement. The technique of Linear Programming is being utilized to achieve the optimum composition of slag (determined from the model) at the least cost.

## 12.21 Leather

**12.21.1 CLRI —** Work on bactericides and fungicides has resulted in obtaining tributyl lead acetate, an effective protective for hides and skins; it has been found that it prevents growth of *Aspergillus niger*, *A. flavus*, *A. terreus*, etc. in skins and hides even in concentration of 0.5 p.p.m.

12.21.1.1 A new electron microscopical technique has been evolved for obtaining electron micrographs of collagen fibres free of adhering fibrils; this will greatly help study of surface properties of tanned collagen fibres.

12.21.1.2 Bleaching studies on buffalo and goat hair and sheep wool have shown that sodium carbonate and sodium peroxide can be used effectively for bleaching purposes; they bleach with minimum loss in tensile strength and matting of fibres and simultaneously improve the lustre and feel.

12.21.1.3 Surgical sutures have been produced for supply to the Defence Research Laboratory at Kanpur and about $ 70 worth sold to two parties in West Germany. A new technique employing glass tubes has been adopted for packing both plain and chromic sutures of different grades; the glass containers fulfil B. P. standard requirements in respect of sterility, length and strength.

12.21.1.4 Sausage casings have been produced for supply to UAR.

12.21.1.5 A blended extract, CHM-I, prepared from indigenous sources, has proved to be a good tanning material adaptable for drum, bag and pit tannage systems. An improvement in tanning of sole leather with myrobalan, resulting in maximum utilization of tannins, has been effected by pre-tanning with formaldehyde.

12.21.1.6 Cashew husk has been used successfully as a reducing agent for the preparation of chrome liquors. The cashew husk reduced liquor has been found to be suitable for pre-tanning of sole leathers.

12.21.1.7 Shark skins obtained from Gujarat have been chrome-tanned successfully; the leather is attractive and goods like chappals, shoes, wallets have been made out of the leather with a shrunken grain finish for introduction in the trade. Studies on defective papra skins have yielded promising results; the least defective 20/25 per cent of these have been found fit for the production of grain garment leathers; the next best 20/25 per cent of 45/50 per cent with the maximum defects have been found to be suitable for vegetable tanned and natural coloured lining leathers.

12.21.1.8 VINALAC 5268, an indigenous adhesive, has been successfully substituted in formulation of Belting Cement NC. Two top dress formulations viz., MS and MSS have been formulated; they have been found useful for leather finishing purposes. Syntans viz., PC, NB, PN, PNS, Picktan N etc., developed in CLRI have been reported acceptable to trade; they have different applications in tanning; two light fast syntans have also been developed. Stable acrylic emulsions with capacity for good film formation have also been formulated. A shellac acrylate copolymer which helps greatly the stability of the emulsion has been formulated successfully. This acryl combination gives a high gloss finish.

12.21.1.9 A process has been worked out for manufacture of tannic acid from dhawa leaves; yield of acid is about 10 per cent on dry leaves. Vegetable tannin extracts worth Rs 1 lakh have been produced.

12.21.1.10 Several new designs have been introduced in leather goods with artistic touches of batik, beads, etc. Tie, card, etc., cases as also jewel cases and ladies wallets with and without frame have been made out of shrunken grain, aniline and E. I. tanned goat, as also shark skin leathers.

## 12.22 Museology

**12.22.1 BITM —** The renovated gallery on 'Motive Power' was opened to the visitors on Dec. 9, 1966. It consisted of a number of static and working models, dioramas and exhibits depicting the systematic development of motive power since the earliest times.

12.22.1.1 The following exhibits were added to different galleries: (i) Pit top layout; (ii) Improved lofco pit top layout; (iii) Lofco pit top layout; (iv) Skip loading; (v) Axial flow fan (Mining gallery); (vi) Sectional model of coke-oven (Iron and steel gallery); (vii) Model of the Indian reactor 'Apsara' (Nuclear physics gallery); (viii) Parallel mirrors (Popular science gallery); (ix) Cable manufacturing plant; (x) Cut-section ceiling fan motor (Electricity gallery), and (xi) Baudot telegraph instruments (Communication gallery).

12.22.1.2 A bus carrying the mobile science exhibits on 'Transformation of Energy' was commissioned on Dec. 26, 1966. Christened as 'Museobus', the museum on wheels carries 28 working exhibits which cover a wide range of fields such as solar energy, space rocket, muscle power and tools, future sources of energy, power of an atom, electricity from sunrays.

12.22.1.3 Besides arranging regular scientific and technical film shows, some special films borrowed from other organizations were shown. A number of popular lectures were also arranged. A science exhibition was organized for children and the public. The museum participated in four temporary exhibitions arranged by outside organizations.

12.22.1.4 The attendance of visitors during the year was 1,60,872 including 13,185 students from different institutions of the country composed of 352 organized groups. More than 2 lakhs of people including students visited the Mobile Science Museum Exhibitions arranged in different places

**12.22.2 VITM —** The following models and exhibits have been acquired during the year: (i) Pelton Wheel Runner; (ii) Data Processing Equipment (21 column ICJ); (iii) Demonstration capacitor and sample cables; (iv) telephone and telegraph apparatus; (v) manual exchange and cross bar switch; (vi) replica of original apparatus of Sir J. C. Bose; (vii) cut-section model of diesel engine; (viii) Kolar Gold Mines model; (ix) sectionized chasis of a 'Chevrolet' motor car; (x) Orpheus jet engine model; (xi) spark plugs 'Bosch' 18; (xii) hot air engine driving fan; (xiii) table telephone ringing battery; (xiv) vertical marine type compound steam engine; (xv) horizontal single cylinder steam engine; (xvi) panel showing the link mechanism; (xvii) model of Trevethick high pressure steam engine; (xviii) panel showing different types of slide valves; and (xix) facit H 95-6 calculating machine.

12.22.2.1 The following exhibits were acquired on loan: (i) sulphuric acid plant; (ii) phthalic anhydride plant; (iii) complex fertiliser plant; (iv) ammonium nitrate fertiliser plant; (v) triple superphosphate fertiliser plant; (vi) Ruston & Hornsby gas engine (7.5 H.P.) (vii) Branca's steam engine, and (viii) Baudot telegraph parts.

12.22.2.2 The following models and exhibits have been designed and fabricated: Diorama of (i) Sir K. Seshadri Iyer power station, Sivasamudram; (ii) ancient stone lifting device (crane) utilizing human power; (iii) water driven hammer forge; (iv) model of wind mills—Dutch octagonal drainage type and tower type; (v) over-short wheel; and (vi) cycloid and its properties.

12.22.2.3 A hand-operated machine has been designed and fabricated to make small corrugated metal sheets for model making work. A high frequency milli-voltmeter of amplifier-rectifier type with cathode follower input has been fabricated.

12.22.2.4 Work on the setting up of a gallery on 'Motive Power' has been completed. The planning work of a gallery on 'Physical Science' has been completed and the model making work is in progress.

12.23.2.5 Experimental work was carried out on the following: (i) A small adding machine to show the fundamentals of computing machines; (ii) a new animation technique with moving lights; (iii) a tape recorder with automatic operational circuits; (iv) an exhibit for demonstrating the principle of total internal reflection using Perspex rod; (v) special lighting effects on the dioramas and exhibits in the Motive Power Gallery and (vi) an exhibit using light bulbs to show volumetrically the various laws of arithmetic.

12.22.2.6 During the year 2,52,785 visitors went round the exhibits. The attendance for the 116 scientific and technical films shown was 16,358 persons.

## 13.0 PROGRESS OF WORK IN DIRECTORATES/ ORGANIZATIONS

**13.1 CDEO —** Detailed designs for sodium cell of 2500 amp. and the salt purification system to produce 450 kg. of pure salt per day have been completed for CECRI. Detailed designs for the distillation of 1350 tonnes of Mentha herb per season for the Chakrohi Farm of RRL, Jammu have also been completed.

13.1.2 The process engineering for the production of 3 tonnes per day of manganese metal is being worked out on the basis of the pilot plant work done at NML.

13.1.3 Engineering design of a plant to produce 15 tonnes/hr of granulated mixed NPK fertilizers has been undertaken at the request of *Rallis (India) Ltd* on agreement of payment of Rs 1.00 lakh for the services to be rendered by the Organization.

13.1.4 The following project/feasibility reports were undertaken and completed during the year: (i) project report for the production of 1000 tonnes of Syntans per annum, based on the pilot plant work done at CLRI; (ii) project report for the production of three types of Air Depolarized cells (80,000 cells per year of AWC-2 type, 40,000 cells per year of AWC-1 type and 20,000 cells per year of AW-4 type) based on the process developed by CECRI; the report has been prepared in collaboration with *Carbon Industries Pvt. Ltd*, Madras & CECRI, Karaikudi; (iii) the project report for LTC for the Govt of Maharashtra in collaboration with RRL, Hyd. for a fee of Rs 50,000; and (iv) feasibility report on the manufacture of 600 tonnes/year of graphite crucibles, based on the work done at NML.

13.1.5 The following development projects have been undertaken in collaboration with industry: (i) designs of diaphragm cells of 10,000 amp. capacity for caustic soda manufacture in collaboration with *Mettur Chemicals* and CECRI. *Mettur Chemicals* have agreed to build the prototype and instal it at their works at Mettur; (ii) designs for a commercial sodium Cell of 10,000 amp. capacity on the basis of work done in CECRI. *Mettur Chemicals*, who are collaborating in the project have agreed to build the prototype and instal it at their works at Mettur.

13.1.6 Exploratory studies and developmental work on the following projects have been undertaken in collaboration with various national laboratories.

13.1.7 Manufacture of (i) benzene hexachloride, (ii) silicon carbide of various grades, (iii) wet ground mica, (iv) spray drying equipment, (v) Lindane, (vi) sodium nitrite and nitrate, (vii) particle board without the use of binder, (viii) iodized salt using imported iodine, and (ix) important pesticides likely to be used in India.

**13.2 DRCIL —** The Directorate took active steps to organize systematic follow up of the recommendations made by the 'First Get-together of Research & Industry', held in December 1965, initiation of high priority national research projects of economic and industrial importance, forging closer contacts with industries and achieving effective coordination with the Ministry of Industry, Directorate General of Technical Development, Ministries of Defence, Food and Agriculture, Health and Family Planning, Railways, Posts and Telegraphs and other user organizations.

13.2.1 Out of 237 national research projects, the economic and technical feasibility of 166 projects was established and action initiated to examine the financial assistance required for 128 projects through a Screening Committee.

13.2.2 The Technical Information Centre for Chemical Industry at Bombay intensified its efforts for closer liaison between the Council and

in regard to research, value of imported chemicals and production by chemical industries. During the period of ten months, 832 enquiries were received by the Centre from 443 parties. The Centre arranged twelve liaison meetings between the technical personnel of industry and scientists of the National Laboratories.

13.2.3 The Technical Information & Liaison Cell for Small Industries rendered assistance to the Small Industries Service Institutes and industries in the small scale sector by supplying them with technical information and guidance. During the period, 296 technical enquiries in addition to general enquiries were received. Information regarding substitution of imported raw materials, utilization of industrial and agricultural wastes and projects of interest to small scale industries has been obtained and is being disseminated through the Information News Letter.

13.2.4 With the object of avoiding possible overlapping of work and maximum utilization of research efforts, inter-laboratory meetings of scientists working in the same field in different laboratories were organized. The specific fields of research in which such meetings were organized during the year are: (i) Ferrites (NPL, RRL Hyd. NML, NCL, Defence and Solid State Physics Laboratory) ; (ii) Enzymes (NCL, CFTRI, IIS, and industrial firms); and (iii) Utilization of results of research on buildings and road construction (CBRI, CRRI, SERC).

13.2.5 A Cooperative Research Association for Electronics Industry was registered during the year, bringing the total number of Cooperative Research Associations to 12. An opinion survey for formation of Cooperative Research Association for Cable Industry has been completed and that for Paper Industry is in progress.

13.2.6 With a view to keeping the research laboratories apprised of industrial licensing and growth of the industry and the Government of the know-how available, the CSIR through this Directorate is represented on the Licencing, Foreign Agreements and Capital Goods Committees of the Ministry of Industry. Applications for Industrial Licences received by the Ministry are scrutinized to locate the projects of interest to the Council and with a view to finding out cases where indigenous know-how is available or could be developed in a reasonable period. During the year, 1261 licence applications were received out of which 425 were of interest to the Council. There were 66 cases where status of indigenous technology and know-how was conveyed to the Ministry of Industry. Attention of the Foreign Agreements Committee was drawn to 7 cases where foreign collaboration was not felt necessary. Of the applications received for establishment of industries based on foreign know-how, ten applicants were invited for discussion on the possibility of utilization of process know-how available indigenously. In most cases the parties agreed to avoid the payment of royalty to foreign consultants or to forego the use of imported know-how.

13.2.7 Two meetings of the Coordination Committee of the Ministry of Health and CSIR were held. The meetings in particular discussed specific fields where CSIR laboratories may collaborate for solution of problems concerning health such as: (i) Improving leakage of water taps (CPHERI); (ii) oxidation ponds (CPHERI), (iii) repairs and maintenance of equipment (CSIO), (iv) production of agar-agar (CSMCRI), (v) mechanical composting plants (CPHERI & CDEO) and (vi) import substitution of drugs (CDRI)

mittee has been the need and possibility of exchange of scientists between the laboratories of Ministry of Health, ICMR and CSIR.

13.2.8 Steps were taken to establish closer links between the Railways and CSIR laboratories. Meetings were arranged with the representatives of the Railways particularly for achieving collaboration in respect of manufacture of air depolarized cells, shatter-proof signal lenses, doublet combination lenses, etc. Problems of developing instrumentation for track recording, equipment and circuitry for data acquisition system have been referred to NAL, reflecting sheet material to CGCRI/SRI/NCL, roofing felt to RRL Hyd., etc. At present, 30 problems of Railways are being pursued by different CSIR laboratories.

13.2.9 The following problems referred by the P & T Department have been taken up for solution: Bundle tying machine (NPL), stamp emitters (CMERI) and scrimbacked paper for envelopes (RRL Hyd.)

13.2.10 As a step to forge closer collaboration with universities, information has been collected and compiled regarding the research projects in progress in universities and other advanced centres of research.

13.2.11 At the instance of Parliamentary and Scientific Committee of the Parliament an 'Exhibition on Self-reliance through Science and Technology' was organized in May 1966 in the Parliament House Compound. The Exhibition arranged in collaboration with the Ministry of Defence, Atomic Energy Commission, Directorate General of Technical Development, CSIR laboratories and industries utilizing CSIR processes, reflected the scientific and technological achievements and advancements primarily aimed to achieve self-sufficiency in the fields of industry, defence and instrumentation.

13.2.12 In addition to bringing out the 'Information News Letter' (Quarterly) and 'Data on Research Utilization' (Monthly), the Directorate released two publications entitled (1) Data on Research Utilization — 1965 and (2) CSIR processes in production. A revised edition of the publication 'Specialized/Fabricated instruments and equipment available in CSIR Laboratories' has been compiled. The proceedings of the First Get-together of Research & Industry (17 volumes) were also published.

13.2.13 During the year, 86 processes were released to industry on royalty-premium or as technical aid basis bringing the total to 232 out of which 81 processes are in production. Besides 41 processes are in production on the prototype plants of the laboratories. The total value of products produced under these processes up to the end of March 1966 is estimated at over Rs 107 million. Twenty-three processes were released free of charge during the year. Some of the processes released free of charge are also in production.

13.2.14 The total amount accruing from premia, royalty, consultation, testing, analysis and other services during the year 1966 is estimated at Rs 1,486,022 as detailed: Premia, Rs 22,000; Royalty, 5,55,548; Project reports, Technical aid, etc. Rs 1,14,190; Consultation fee, Rs 1,24,278; and Testing, analysis and other services, Rs 6,70,006.

**13.2.15 DCU —** Eighty-nine new items were referred to the Unit for examining possibility of developing know-how for their production in the country. These included 53 items hitherto imported, referred by Technical Committee on Medical Stores (TCMS) of the Department of Defence Sup-

cases, the CSIR laboratories have agreed to take up investigation work. Most of the items referred by TCMS were required in small quantities for which reason development work was not initiated in preference to others whose demand is more.

13.2.15.1 The Unit also took up follow-up action in collaboration with the Department of Defence Supplies on 48 projects, which were assigned to the Council's laboratories on the recommendation of Working Groups constituted by Emergency Sub-committee of the Scientific Advisory Committee to the Cabinet.

13.2.15.2 The present position of current projects is as follows: Total number of projects, 185; know-how developed and items being produced on pilot plant, 31; know-how developed on laboratory scale and pilot plant being set up for some of them, 43; and development work in progress, 111.

**13.2.16 Patents Unit —** One hundred and ten patent applications were filed during the year; of these six were filed in foreign countries. The institution-wise distribution of patent applications filed, accepted and sealed in India and elsewhere is given in App. 10.

**13.3 DSTP —** Particulars of over 73,000 scientific and technical personnel (including some abroad) were incorporated in the National Register of Scientific and Technical Personnel. The Register at present contains data regarding 3,48,400 persons composed of 1,32,600 scientists, 1,38,000 engineers and technologists, 77,000 medical personnel and 800 persons in other categories. This includes 54,600 diploma level engineers and 79,200 science graduates.

13.3.1 The number of persons registered in the Indians Abroad Section was 1,063, bringing the total number enrolled to 12,113. The category-wise break-up of the total enrolment was Scientists 3,754, Technologists 946, Engineers 5,279 and Medical Personnel 2,134. Besides these 49 Social Scientists and 16 candidates with qualifications in business management and accountancy have also been enrolled bringing the total in these fields to about 700.

13.3.2 An inter-census revision of data on scientific and technical personnel has been initiated in cooperation with the Registrar General of India.

13.3.3 Manpower research was continued. Study reports have been published on post-graduate Mathematicians, post-graduate Women Scientists, graduate Civil Engineers, graduate Mechanical Engineers and diploma holding engineers. Special studies on requirements of Mining Engineers and Civil Engineers have been completed. Special surveys regarding the availability and utilization of scientific and technical personnel have been conducted. The following study reports are under preparation: (i) Utilization of graduate engineers; (ii) Utilization of personnel returning from abroad, (iii) Employment outlook for scientific and technical personnel.

13.3.4 As many as 629 persons were selected to the Scientists' Pool during Jan.-Dec., 1966. The total selection up to the end of 1966 was 4856. The number of pool officers working at the end of the year was 543,

13.3.5 Separate registers are being maintained for unemployed technical personnel, pool officers and retired personnel needing employment assistance, Over 3000 vacancies were notified and particulars of over 4,000 persons were forwarded to employing agencies for consideration.

13.3.6 'Technical Manpower' is running its ninth volume. Five Indians Abroad Directories (2 of engineers, 1 of medical personnel and 2 of scientists & technologists) containing the particulars of 319 engineers, 137 medical personnel and 370 scientists and technologists were published during the year. In addition 11 Pool Directories containing particulars of 1,022 persons selected to the Pool were also published.

**13.4 RSPO —** The organization has been engaged in the following activities: (i) Science policy studies, (ii) Methodology and techniques of planning; (iii) Surveys of developments in the existing organizations; and (iv) Imparting training to scientists from abroad in the field of planning of scientific research.

13.4.1 Science policy studies and literature search relating to the growth of science and technology in India have been undertaken, and a draft report has been prepared on Science Policy in India. Flight of scientific and technical personnel which affects problems of education and manpower exploitation of natural resources has been looked into from different angles, with particular reference to India. From the available data, it is inferred that restricted repatriation based on the realistic assessment of stock, wastage, and differential growth of high level manpower in the country, is likely to be better than the procedure now being employed.

13.4.2 A pilot study to develop appropriate methodology for project-wise research programming has been completed in six national laboratories. A case study on evaluation of research projects in CLRI has been undertaken. First phase of the study has given certain clues on the problems of initiation and execution and utilization of the research output.

13.4.3 A review of the current trends of research in botany in India has been completed and data pertaining to the field of zoology for the period 1954-64 are being classified and analysed. Study of trends in current research in electronic and mechanical engineering has been undertaken. This closely follows the pattern of current trends in botany, etc. Study of infra-structures with particular reference to direct costs involved, various projects to be undertaken and their proportional expenditure, has been undertaken.

13.4.4 Data have been collected on the Fourth Plan financial requirements with different breakdowns for some national laboratories.

13.4.5 An analysis of foreign assistance to scientific research in India has been completed and published. The analysis which has been made in terms of (i) sources of assistance, (ii) recipient agencies and (iii) fields of research, for the present, covers only six sources of assistance, viz., Colombo Plan, United Nations Special Fund, United Nations Expanded Programme of Technical Assistance, P.L. 480, Ford Foundation and Rockefeller Foundation.

13.4.6 An analysis of trends in state support to research in India has revealed that (i) Indian expenditure on scientific research in terms of percentage of national income, government expenditure and capital investment

research; (iii) there is considerable imbalance between allocations even among institutes; and (iv) more provision than that at present is necessary under capital for equipment, library and other facilities.

13.4.7 The following studies have been undertaken: Survey of textile (including man-made fabrics) and iron and steel industry to understand their research needs and available research potential, relationship between research, management and production, mode of research communication between laboratory and industrial units, and mechanism of decision making; opinion survey of scientists and technologists in different organizations in India; survey of scientific journals, scientific societies; and trend of research in agricultural and animal husbandry stations, and in academic (teaching) institutions.

**13.5 PPRU** — The unit continued to issue news stories and features to the press, radio and other media units describing the new processes and products evolved by national laboratories. Two exhibitions 'Self-reliance through Science & Technology' and 'Our India Exhibition' were held in New Delhi during the year to portray the important achievements in the field of scientific and industrial research in the country during the post-independence era. Most of the national laboratories participated in these exhibitions.

**13.6 Insdoc** — The demand for the documentation service offered by Insdoc has been steadily increasing. The Centre at New Delhi processed 15,465 documents, compiled 192 bibliographies and undertook 834 translations during the year as against 14,376 documents, 160 bibliographies and 838 translations last year. Copies of 1945 documents were supplied by the Bangalore Centre. Translation of a large number of standards from Russian language to English was undertaken as an assignment from the *Hindustan Aeronautics Ltd.* Considerable translation work from Russian to English has also been taken up for the Central Water and Power Commission in respect of setting up of the Thermal Power Institute in Delhi.

13.6.1 Special mention may be made of the following bibliographies: Work done in India on virus and virus diseases during 1900-64 with entries classified and arranged following Andrewes book on Virus of Vertebrates (Virus Research Centre); work done in India on agro-chemicals (in connection with proposed setting up of an Institute in the field); Bibliography on Metropolitan Areas in Asia for inclusion in the publication of International Union of Local Authorities, The Hague (at the request of the South East Asian Regional Town Planning Organization, New Delhi); and Bibliography on Education for Librarianship, 1955-66 (on the occasion of the Seminar on Teaching of Library Science convened by the Delhi University).

13.6.2 Insdoc has signed a contract with the National Science Foundation for the compilation and publication of an Annotated Quarterly Bibliography of Indian Educational Materials. Work was started on this project and the first issue of the Bibliography was brought out in January 1967.

13.6.3 There has also been steady demand for the supply of photocopies of scientific papers; photocopies numbering to 3,330 printed pages were supplied.

13.6.4 The Centre continued to issue Indian Science Abstracts (monthly) and Annals of Library Science and Documentation (quarterly). The annually on the periodicals on subscription is Rs 20,000 and through exchange for foreign periodicals Rs 45,000.

13.6.5 Besides, the following *ad hoc* publications have also been brought out: (i) catalogue of Serials, in the Indian Institute of Science Library, Bangalore and (ii) Catalogues of Serials in the Indian Statistical Institution, Calcutta.

13.6.6 The proceedings of the Symposium on 'Water Evaporation Control' organized by the Unesco South Asia Science Cooperation Office, New Delhi in collaboration with CSIR were also printed.

13.6.7 The National Science Library which has been appointed by the Government of India to function as the centralized agency for exchange of publications with a number of East European Countries such as Hungary, Rumania, Bulgaria and USSR. At present Insdoc is receiving 2,217 periodicals — 874 periodicals by subscription, 857 by exchange and 486 on complimentary basis. It has exchange arrangement with 227 organizations from 46 countries and 97 organizations in India. It receives Japanese and Australian patents on exchange basis.

13.6.8 The library receives 486 titles on complimentary basis from 200 foreign organizations from 40 countries and from a number of Indian organizations. It also acquires, as a policy, all worthwhile scientific periodicals published in India. In addition to this, the library receives 230 abstracting and indexing periodicals and 70 cover-to-cover translations of Russian periodicals.

13.6.9 The NSL has acquired 3,412 books and 520 pamphlets. Copies of Doctoral theses in science subjects from the Universities of Andhra, Annamalai, Lucknow and Madras are also received. Theses were got on loan from Universities of Baroda and Osmania and the Indian Institute of Technology, Kharagpur for microfilming.

13.6.10 The third in the series of Union Catalogue was published in August 1966. It covers the holdings of the Indian Statistical Institute, Calcutta and contains 2,950 titles. Compilation of catalogue of Serials in the Indian Agricultural Research Institute, New Delhi, covering about 5,000 titles has been completed.

13.6.11 Insdoc has taken active interest in information retrieval. Preliminary work has been completed for preparation of author index of monthly issues and annual volume of Indian Science Abstracts (ISA) using computer. The author index of monthly issues of volume II of ISA is being computer produced. Basic experiment on data retrieval has been designed and conducted.

13.6.12 The Insdoc Centre, Bangalore, started providing document procurement service, reprographic service, compilation of *ad hoc* bibliographies and answering technical enquiries during the year.

13.6.13 Insdoc has conducted two training courses, a seminar and arranged an exhibition.

**13.7 PID** — The encyclopaedic publication, The Wealth of India—Raw Materials, Vol. VII, covering the alphabets N-Pe has been brought out.

*Nicotiana* (Tobacco), *Oryza* (Rice), *Papaver* (Opium), *Pennisetum* (Bajra), Oysters and Petroleum.

13.7.1 The articles for vol. VIII of the Raw Materials series (Ph-Py, Q & R) are being press-readied. The volume includes 197 articles on plants, 4 on animal and animal products and 6 on minerals. Among the major and important ones are: *Phaseolus* (beans), *Phoenix* (date palm), *Pinus* (Pines), *Piper* (pepper), *Pisum* (peas), *Pogostemon*, *Polygonum*, *Pongamia* (Karanj), *Prosopis* (Mesquite beans), *Prunus* (stone fruits), *Psidium* (guava), *Psoralia* (babchi), *Pterocarpus*, *Raphanus* (raddish), *Rauvolfia*, *Ricinus* (castor) and *Rubus* (raspberry) among plants; Prawns, Shrimps and Lobsters among animals and Phosphates and Quartz among minerals. Drafting of the main chapters of the article on Livestock to be issued as a supplement to Vol. VI has been completed.

13.7.2 Compilation of articles for Part VII of the Industrial Products series is in progress. This part includes 26 articles covering Pl through Sh, the major articles being Plastics, Plywood, Power, Printing, Processed Foods, Railway sleepers, Rayon, Refractories, Rubber, Salt and Ship-building.

13.7.3 Nine volumes of the Wealth of India series were presented to the National Research Council of Canada on the occasion of its fiftieth anniversary.

13.7.4 Monograph No. 4, *Indian Fossil Pteridophytes* (K. R. Surange) in the botanical Monograph series has been published. Manuscripts of Monograph No. 5, *An Introduction to Taxonomy of Indian Mosses* (R. S. Chopra) are being processed. Manuscripts of *Evolution of Life* (M.S. Randhawa *et al.*) have been edited and sent to press. Manuscripts of Memoir No. 1, *Millipede* (G. Krishnan) in the Zoological Monograph series have been press-readied.

13.7.5 The periodicals, the Journal of Scientific & Industrial Research (Vol. 25), Indian Journal of Chemistry, Indian Journal of Pure & Applied Physics, Indian Journal of Technology (Vol. 4), Indian Journal of Experimental Biology (Vol. 4), Indian Journal of Biochemistry (Vol. 3), Research and Industry (Vol. 11), and CSIR News (Vol. 16) were issued during the year. The first journal, which completed 25 years of service to the scientific community published 51 review articles. The number of pages published in the eight periodicals totalled nearly 3,000 pages. Over 700 research papers were published in the research periodicals.

13.7.6 The papers of the Symposium on Glycosides and Saponins (organized by Drugs & Pharmaceuticals Research Committee) were processed and press-readied. Material for the revised edition of the brochure 'CSIR Laboratories & Units' has been compiled.

13.7.7 An *ad hoc* publication, *Illustrations to The Flora of Delhi* (J. K. Maheshwari) was brought out.

13.7.8 The Directorate also undertook, on behalf of other CSIR organizations, the editing and production of: (i) CNS Drugs—A Symposium (on behalf of RRL, Hyd.), (ii) Nine volumes of the First Get-toge ther of Research and Industry—Working Groups 1-5 and 10-13, besides Addresses and Key Papers (on behalf of DRCIL), and (iii) Survey Reports 5 and 7, and Annual Report of RSPO, 1965-66 (on behalf of RSPO). Two booklets,

13.7.9 The Documentation unit of the Directorate evaluated about 500 articles from primary periodicals and 5,000 articles from abstracting periodicals. About 15,000 index entries were made and filed in the catalogue during the year, bringing the total number of entries to about 22,300.

13.7.10 The list of publications brought out by the Directorate as also those of other institutions of the Council is given in Appendix 13.

**13.8 SRU** — The outstanding attainment of the Unit during the year was the production of Bhabha Number (October). Containing articles by scientists of international distinction like the Nobel Laureate Prof. C. F. Powell, Prof. S. Chandrasekar FRS, Prof. Abdus Salam FRS, Dr W. Heitler FRS, Dr D. S. Kothari, Dr Jerome B. Wiesner, Dr B. Goldschmidt, Dr S. Eklund, Dr W. B. Lewis and Dr B. Peters, the issue received wide acclaim both inside the country and abroad.

13.8.1 During the year the magazine received and published articles from such eminent scientists as Dr D. W. Sciama, Dr S. Dedijer, Dr B. R. Sen (Director-General, FAO), Prof. Serge A. Korff, Dr Alex Comfort, Dr Everette L. May, Prof. A. G. Gaydon, Dr E. Schlittler, Dr Kip S. Thorne and Dr Alan Maxwell.

13.8.2 Several new permanent columns were introduced, viz. Letters, News & Notes, Medical Notes of the month, and Science for the Young.

**13.9 ILU** — The Unit continued to publish the CSIR's popular science monthly Hindi journal, 'Vigyan Pragati'. One special number, viz. Self-Reliance Number, was also brought out.

13.9.1 Subscription to 'Vigyan Pragati' has now gone up to about 13,000.

13.9.2 With a view to feeding the language press with information relating to the scientific and technological development and research in the country and abroad, the Unit continued to issue Science Information Bulletins in Hindi and Marathi. Since May 1966, similar bulletins are being issued in Malayalam also.

13.9.3 A grant of Rs 1.5 lakhs was sanctioned by the Ministry of Education for the production of popular science books. Against this Grant, as many as twenty-one popular science books in several Indian languages and a bibliography entitled 'Directory of Hindi Scientific & Technical Publications: 1965' were published.

13.9.4 On a request received from the Indian National Commission for Cooperation with Unesco, the brochure entitled, 'Unesco—what it is, what it does, how it works' was translated and produced in Hindi, Bengali, Marathi, Tamil and Malayalam.

13.9.5 The Annual Report of CSIR for 1965-66 was published in Hindi.

13.9.6 Details of the publications brought out by the Unit are given in App. 13.

## 14.0 BRIEF RECORD OF SPONSORED RESEARCH

### 14.1 Cooperative Research Associations

fibres, in the natural and swollen states have been carried out to obtain basic information on the modifications in cotton structure produced by swelling treatments. A new technique for measurement of the refractive index of fibres has been developed. Studies on the chemical modifications of starches and other polysaccharides have been continued not only to produce new types of products but also to understand the relation between polysaccharide structure and properties. The adsorption of dyes and chemicals from aqueous solutions on cotton fibre surface has been studied; the study shows that the internal surface area available under dyeing conditions is of the same order of magnitude as that obtained with nitrogen adsorption.

14.1.1.1 Studies of the carding process have led to the establishment of certain indices for measurement of carding quality. The effect of various processing parameters on these indices has been intensively studied. Further data have been obtained on improvements in twist flow in ring spinning and the benefits of such improvements in terms of increasing productivity are being systematically evaluated. A detailed study of the combing process has been undertaken to examine the effect of different levels of waste extraction on quality of combing as well as of the end-product, viz. yarn. Working of non-automatic looms is being studied to see the contribution of various factors to warp breakage during weaving and to evaluate various modifications of the loom to reduce breakages.

14.1.1.2 Intensive research has been undertaken to develop new types of chemical finishes for cotton yarns and fabrics in order to strengthen the competitive position of cotton with respect to man-made fibres. Promising results on a laboratory and semi-pilot plant scale have been obtained in production of permanent press, wash and wear cotton-polyester blend fabrics and of cotton and cotton-polyester blend yarns with a high degree of stretch.

14.1.1.3 The catalytic oxidation process for modification of starches has been evaluated on a pilot plant scale and the performance of the modified products is being studied.

14.1.1.4 Based on research on drying carried out last year, modifications of the cylinder drying range have been designed and implemented in four textile mills. Large scale working has confirmed the expected increase in productivity of 25 to 35 per cent. Several studies of fuel economy, heat balance, steam distribution and humidification have been carried out in textile mills. A beginning has been made in the project on improving washing efficiencies by collecting detailed data in three mills on the performance efficiency of three types of washing machines as well as on the quantities of water consumption in different processes. Improved materials handling methods have been developed in certain processes in one textile mill.

14.1.1.5 As many as 40 technical and operational surveys have been undertaken in spinning, weaving, sizing, bleaching and dyeing departments of a number of mills. Specific recommendations have been made in these surveys for quality and performance. Inter-firm comparison surveys of productivity and quality in the spinning and weaving departments have been completed for a large number of member mills. Another such survey for consumption of stores and accessories has been initiated.

14.1.1.6 Inter-firm comparison of internal production costs has also been initiated this year for about 20 mills. A detailed study of production

14.1.1.7 Systems and computer programmes have been developed for quick and accurate analysis of the commitment position, stock position and of product costing as a first step towards more effective management control on sales and production planning. Several computer programmes have also been developed for analysis of the data obtained in various surveys mentioned earlier as well as for certain research projects in the laboratory.

14.1.1.8 The supervisory training and development programme drawn up last year has been implemented in four mills. Several new personnel procedures are also being introduced in these mills to provide the necessary climate for personnel development.

14.1.1.9 Earlier activity on development of equipment for quality control and process control has been intensified and several new instruments are at an advanced stage of development.

**14.1.2 BTRA —** The results of the two defence projects, on increasing the wearlife of army drill and on producing water-repellent finishes on fabric have been accepted by the Defence Department and field trials on the basis of these results are already under way at their end. The latter project has possibilities of import substitution.

14.1.2.1 A new technique has been successfully worked out for resin formation *in situ* in cellulosic materials. A fabric finished by this process exhibits better crease recovery, both wet and dry, for relatively less resin add-on with improved durability to washings compared to conventional finish. Letters patent has been granted to this process.

14.1.2.2 Bleaching trials of textiles with peracetic acid have been successful. As this method of bleaching is not practised in the country, the know-how of this process is in great demand. There is great potential for its industrial application, specially for blends with man-made fibres Besides peracetic acid could also be used in bleaching as a substitute for imported sodium chlorite.

14.1.2.3 Ad hoc studies that have been conducted on the problem of curling of selvedges in woven fabrics have shown that the selvedges should be tighter and extensible so that during processing the tension is first taken up by the selvedge and then by the body thus helping the selvedge to remain straight without folds. A research project based on this work has been sponsored under the PL-480 scheme.

14.1.2.4 Investigations on the streakiness of poplins have helped to establish that this defect is due to short terms variations in spacing of reed-dents. The defect is enhanced or obscured or a streak is formed even if the dents are regularly placed on account of short term variations in yarn. This variation is found to be more marked in pitch-baulked reeds than in all-metal ones. The shirley reed and cloth gratings, although a handy tool for this work, do not give a quantitative estimation of the defect.

14.1.2.5 Studies on high-production carding and the effect of Crosrol Varga unit on the strength and cleanliness of the yarn have shown that the use of Crosrol Varga did not contribute to any loss in strength of fibres and that there was marked improvement in yarn cleanliness. It was found that the cleanest cloth sample was the one woven from the yarn which was processed on high production card with maximum nip pressure on 0.16' hank

14.1.2.6 Fabrication of instruments of immediate use to the mills has been commenced. An automatic wrap reel for easy and rapid determination of yarn count and strength has been fabricated and already some wrap reels have been supplied to certain mills. An automatic wrap block for determination of silver and roving hanks is also ready for use. Besides, a few electronic instruments have progressed to the stage of completion.

14.1.2.7 The factors that contribute to the wear-life of apparel fabrics in actual use have been taken up for study. Work on the wear index of some drills, according to the method of Stoll, has already been completed. Fabric to fabric abrasion is now being studied on a number of cotton drill fabrics of similar construction with a Hungarian abrasion tester.

14.1.2.8 Studies relating to operations research etc. are being conducted on the mills' shop floor from time to time and suitable recommendation made.

**14.1.3 SASMIRA —** A study of the effect of steam/dry heat setting on polyamide twisted yarns has shown that (i) for nylon filament yarns there is a linear increase of shrinkage with increase in temperature of setting; (ii) shrinkage with dry heat is less as compared to steam heat; and (iii) there is greater loss of strength in nylon 6 than nylon 66.

14.1.3.1 The mechanism of nylon fabric shrinkage and the role of yarn crimp and length changes has been studied in fabrics with varying ends and picks. The bending rigidity of yarns in woven structure has been found to depend upon factors such as number of filaments, twist, shrinkage. The number of ends and picks interlacing have an effect on the crimp of yarns and the shrinkage on boiling.

14.1.3.2 Investigations on some aspects of degradation of polyamide filament yarns have shown that (i) indigenous nylon 6 is more susceptible to thermal and chemical degradation than imported nylon 66 and reverse is the case in respect of photo-degradation and (ii) vat-dyed nylon yarns degrade much more than undyed yarns when exposed to ultraviolet radiation.

14.1.3.3 A comparative study of characteristics of indigenous and imported transparent cellulose papers for packing of textile goods, revealed that indigenous papers are inferior in respect of water vapour permeability, blocking and ease of separation of layers compared to imported papers. However, the tensile strength of indigenous papers in machine direction was higher than that of imported papers.

14.1.3.4 A study of foam-backed textiles has been made. A laboratory type mangle has been developed and a few fabrics of nylon and acrylic serge were laminated with polyurethane foam on it by adhesive system of bonding. Very good results have been obtained as regards weight and thermal insulation of the laminated fabric.

14.1.3.5 Spectrophotometric measurements of whiteness and yellowness of fibres by using Beckman Du Model spectrophotometer have shown very good correlation between this method and subjective rating method. Where the subjective rating failed, spectrophotometric measurements have proved valuable in distinguishing close differences.

14.1.3.6 Work on dyeing of natural silk with indigenous reactive dyes

um carbonate for dyeing silk by the alkali method has been worked out. It has also been found that for eri silk the maximum shade that can be obtained with reactive dyes is 4 per cent.

14.1.3.7 Nylon filter fabrics have been developed for the tea industry. Besides, rayon/jute union fabrics have been developed for use as furnishings. A pilling tester for evaluating the pilling properties of synthetic fibre blended fabrics and a laboratory single thread sizing equipment for quick experimental sizing of man-made fibre yarns have been developed.

**14.1.4 SITRA —** The effect of eccentricity of top and bottom rollers in ring spinning frames on yarn properties has been studied.

14.1.4.1 The following testing instruments, essential in maintaining quality and production in mills, which were hitherto imported, have been successfully fabricated and are available to the industry: (i) wrap reel (electrically operated with automatic full stop motion) for reeling either full or half leas from 20 bobbins at a time; (ii) manual yarn examining machine for winding of yarn on black boards; (iii) moisture meter for evaluating moisture contents of materials like cotton, man-made fibres; and (iv) yarn balance for directly determining yarn count.

14.1.4.2 A study of utilization of cotton in mills, covering scope for reducing waste and methods of controlling waste, has been completed. Norms for various categories of waste have been drawn up.

14.1.4.3 Linear programming has been applied in studying minimizing of mixing cost and maximizing profitability. Consequently, a method has been evolved to determine the choice of cotton in a blend for spinning a yarn of certain required quality at minimum cost.

14.1.4.4 Many industry-wise periodical surveys and studies on productivity, profitability, quality, etc. and problems of human relations in the textile industry were carried out. A study on market for non-wearing apparels is in progress.

**14.1.5 WRA —** The Association has launched some projects of immediate practical utility to its member mills. These include the development of optimum blend composition, yarn and cloth geometry for hair belting yarn and a variety of defence requirements.

14.1.5.1 The gross physical characteristics of five graded varieties of Rajasthan wools have been ascertained. It is proposed to assess their spinning performance for the guidance of the mills interested in processing them.

14.1.5.2 Work is in progress for developing a practical method of separating the wool wax from scour liquors and purifying the same.

**14.1.6 IJIRA —** Investigations on a number of samples of jute fibre showed that there is correlation between their lustre and tensile properties. Consequently, a prototype lustre meter has been developed for grading of raw jute quality. The method of test is rapid and direct reading, and does not involve any calculations of results.

14.1.6.1 Comparative evaluation has been made on the special bleaching process developed for jute as against the conventional peroxide method

showed improved light fastness. The bleached samples were subsequently dyed to pastel shades with different dyestuffs.

14.1.6.2 Special jute fabrics suitable for conversion to decorative materials have been developed by using very regular yarns of ordinary and finer counts prepared by employing special processing sequences. These fabrics have highly improved fabric geometry.

14.1.6.3 A project on the 'Development of a New Jute Woolpack' has been concluded. A new type woolpack, much lighter (about 33%) in weight than the conventional packs has been designed using improved fabric geometry and superior fibre mix. These packs satisfy the quality requirements for usual wool pressing and dumping, and have a reduced potential for fibre shedding from the surface, which can contaminate the packed wool. A chemical surface treatment using indigenously available chemicals has also been developed for anchoring protruding fibre to the body of the fabric and hence further minimizing the contamination potential. Manufacture of these packs has been carried out in a semi-bulk scale in industrial units and small scale performance trials of these packs overseas have been encouraging.

14.1.6.4 An antimigrant for preventing migration of jute batching oil from carpet backing fabrics has been developed. This development is expected to have potentialities in a number of other directions such as prevention of migration of oil from hessian to PVC coating, reduction of staining of baled cotton by jute batching oil etc. Bulk trials have been completed on carpet backing fabrics and samples have been sent overseas for testing of reduction of soiling, tuftability of carpet backing, etc.

14.1.6.5 A new technique for laminating polythene with jute fabrics by heat bonding has been tried. Promising results have been obtained. Jute polythene laminates have so far been prepared by using bitumen as an adhesive. Bitumen is undesirable for packing many commodities such as foodstuffs where its migration through polythene can contaminate the packed matrials.

14.1.6.6 The ink usually used for stencilling coating grade fabrics can penetrate through the coating and show up as stains. A non-migrating ink composition has been developed and the method of application demonstrated to member mills.

14.1.6.7 The mechanism of objectionable yellow stains caused by mildew growth on jute materials has been to some extent clarified. It has been inferred that (i) components present in lignin combine with fungal metabolic products, colourless or coloured in themselves, to give water-soluble yellow substances; (ii) metabolic acids sometimes deepen the stain; (iii) relatively few species are capable of giving stain. Some common species which stain have been identified.

**14.1.7 IPIRA —** Trials in a commercial plant of the C. K. T. adhesive developed at the laboratory of the Association have given encouraging results. Interesting possibilities have been inferred on the basis of preliminary studies for the use of tannins from wattle bark received from the Madras Forest Department and for the cashewnut shell liquid adhesive formulation developed at the Association. The study of the relationship between swelling and shrinkage of wood under mechanical restraint was continued.

14.1.7.1 Rheology of tannin adhesive

of creep in plywood and hardboards, demensional stability of plywood and a comparative study of methods of investigating dimensional stability of composite wood products are the other interesting investigations under progress.

**14.1.8 TRA —** Engineering research was concerned as in past years, with the development of continuous or semi-continuous tea processing machinery. Under development and experiment are various new forms of roller and a disc roller. A prototype automatic fermenting and drying machine was installed in a commercial tea factory and run for the first time during the year. Commercial models of the Tocklai continuous Tray Drier came on the market and several are working in estate factories.

14.1.8.1 The programme of work was revised and emphasis will now be placed by the Specialist Departments on obtaining more fundamental information on the growth of the tea bush in relationship to its environment. Lines of prime importance are the effects of sunlight on leaf temperatures and total plant metabolism and also the physical aspects of soils.

14.1.8.2 Field experiments on estates are conducted mostly by the Advisory Department and aim at screening the better of the possible field management methods. Particular attention is being paid at present to lengthening the pruning cycle, irrigation and the possibilities of taking out-of-season crop.

14.1.8.3 Advice given by the Department increased during the year and there are now seven trained Advisory Officers in the field. Lecture courses on a number of subjects were increased. Other practical courses for junior personnel were held at Borbhetta Field Station.

## 14.2 Research Centres

**14.2.1. RCPRC —** Complete analysis of data collected over the past years (20 station seasons) on artificial stimulation of rain using warm cloud seeding technique from ground over the climatologically similar regions, Delhi, Agra and Jaipur has been carried out. The analysis revealed that the net increase in rainfall as a result of seeding was about 40 per cent and that this increase was not due to chance. The results of seeding experiments during this year also confirmed this conclusion. The conservative estimate from these was that the rainfall over these regions can be increased by 20 per cent by adopting this technique. Though seeding from aircraft eliminates the uncertainty of seeds having entered into clouds, this technique is uneconomical. Hence, it has been inferred that concerted efforts be made to find favourable conditions on cloud stimulation by warm cloud seeding from ground in different climatological regions of the country.

14.2.1.1 Simultaneous study for one year of ice forming nuclei and chloride ion concentration in surface air at Delhi appeared to show an inverse relationship between the two, suggesting thereby that this is so because the source of particulate matter is different in the two cases.

14.2.1.2 Studies on measurement of hygroscopic and nonhygroscopic aerosols during pre-monsoon and post-monsoon period up to a height of 10,000 ft on board Beaver aircraft were continued. It has been inferred that in most cases hygroscopic particle concentration decreases with height in

14.2.1.3 Preliminary results on aerosol studies at Calcutta showed that hygroscopic nuclei content varied from one per litre when the wind was from North West or North East to as high as 71 per litre when the wind was from South West or South East, thereby revealing that hygroscopic nuclei concentration could be used as a good air mass indicator.

14.2.1.4 Analysis of rain water samples for chloride ions with progress of rain shower at Delhi seemed to suggest that (i) growth of rain drops in convective clouds often took place as a function of sea-salt nuclei distribution present in cloud air and (ii) the characteristics of precipitation were dependent on the amount of air borne soluble particles present in the cloud forming air. Measurements of gaseous and particulate concentration in respect of $NH_3$, $NO_2$ and chloride in ground air layers at Delhi revealed an annual trend for chloride only. Chemical analysis of precipitation samples collected during rains with and without hail at Nainital and Delhi revealed that hail embryos form on giant hygroscopic aerosols.

14.2.1.5 Estimation of cloud forming nuclei visually was extended to upper levels by collecting air samples on board aircraft from different heights up to 10,000 ft. It has been found that for both pre-monsoon and monsoon period, nuclei concentration is likely to be directly proportional to the extent of impact (or influence) of monsoon or maritime air masses on local weather.

14.2.1.6 Initial study of collision and coalescence between two freely falling droplets of drizzle size range has shown that coalescence just starts when an electric field of strength about 65 volts per centimetre is applied and the extent of wake effect is extended further with the application of field.

14.2.1.7 Preliminary investigation of electrical charges in the atmosphere have been carried out. From the correlation observed between data collected for the earth's potential gradient at surface and upper air and those of hygroscopic and non-hygroscopic nuclei, the possibility of hygroscopic aerosols of sea origin having some charges associated with them has been inferred.

14.2.1.8 Continuation of analysis by radar of seeding trials during the year has also revealed a positive trend of result. In the absence of isoecho contour device which will automatically help in ascertaining the total rainfall of the day around any locality, multiple exposure for 24 hr of radar scope pictures on the same photographic film at regular short intervals and measurement of the echo density in the film at different locations in regular distribution was attempted. The density at some known locations thus evaluated were compared with actual 24 hr rainfall at some places as measured by standard rain gauges and with estimated values obtained by calibration from this value. The preliminary inference from this method was that it was feasible for estimation of total rainfall.

**14.2.2 SRTEE** — Twenty-eight structural response recorder stations have been installed. The scope of observations made in them has been considerably enlarged by the development of more sophisticated accelerographs designed and manufactured at the School. The first four of this type are proposed to be installed on the Ganga and Yamuna Valley projects.

14.2.2.1 The methods of strengthening brick buildings worked out at

in the form of a code of practice for building construction in seismic zones in the country.

14.2.2.2 The following research activities have been continued: Work on dynamic characteristics of masonry buildings, multistorey building frames, unreinforced and reinforced shear walls with openings, water towers having rigid-joined diagonally braced staging and methods of strengthening them against earthquake and blast forces; Behaviour of earth and rockfill dams under seismic disturbances and of pile foundations subjected to lateral loads and liquefaction of sands when subjected to vibrations; and Studies of earthquake occurrence and theoretical studies on elastic wave propagation.

14.2.2.3 The following studies have been taken up : (i)Dynamic characteristics of structures like arches shells and bridges; (ii) properties of soils under dynamic loads; (iii) dynamic earth pressures against retaining walls; (iv) bearing capacity of foundations subjected to moments and inclined loads; (v) study of tectonic features in order to understand the mechanics of earthquake occurrence and delineate the areas into various active zones.

14.2.2.4 Several instruments required for vibration studies, strain measurements and earthquake observations such as vibration pick-ups, shock-type and sinusoidal vibration tables, function generators, soil testing apparatus for dynamic studies, earthquake response recorders, strong motion accelerographs have been designed. This programme of development of instruments has resulted in saving of foreign exchange and has helped in creating a capacity within the country which may eliminate imports of similar equipment in future.

## 14.3 Research Committees

**14.3.1 CEHRC** — One of the most important research projects underway is the development of standard sand for testing purposes and for determining the abrasive resistance of different substances such as building stones. The suitability of Ennore sand (Madras) in this context was undertaken with the object of furthering the results of investigation carried out by the *Associated Cement Company of India*. The study has yielded encouraging results, and India today is in a position to present a material of requisite standards for testing cement mortar and other cementing compounds.

14.3.1.1 Soil erosion caused by rivers and streams in India is another important problem. A visit has been made to certain areas where soil conservation measures have been undertaken. A committee has been appointed to study the formation of ravines in Indian rivers, their causes and cure. A preliminary study of the problem is being made at Chhaleswar Research Station near Agra with the object of collecting sufficient data for formulation of specific studies.

14.3.1.2 The other important schemes in progress are: study of concrete structures in seawater, fly ash as construction material and design of steel gates for storage reservoirs operating with heads on water controlling structures. Considerable headway has been made in these investigations.

**14.3.2 CRC** — The structure of picrinine, a new alkaloid from *Alstonia scholaris*, has been elucidated.

14.3.2.1 A few interesting oxygen heterocycles have been isolated,

isoflavone bioside, from the root bark of *Dalbergia lanceolaria* has been fully elucidated.

14.3.2.2 Kinetic studies of a number of oxidation and reduction reactions, electron transfer and photo-chemical reactions have been made with interesting observations. The kinetics and mechanism of emulsion copolymerization of styrene with alkoxy acrylate have been determined for each monomer and the cross-propagation constant between pairs of monomer have been estimated. A procedure of utilizing heterogeneous exchange reaction and mixed crystal formation has been developed for the separation of thorium from phosphates, calcium and iron (III). Resin membranes have been prepared and successfully used for measurement of activities of single mono and bivalent ions as well as mixtures of such ions.

14.3.2.3 Some of the notable contributions in the field of biochemistry have been on (i) a toxic factor from *Lathyrus* pulse—its metabolic role, (ii) vitamin A and its metabolic role, (iii) nucleic acid synthesis, (iv) mitochondrial synthesis of plant proteins, and (v) biosynthesis of antibiotics.

14.3.2.4 Considerable progress has been made in the following projects: (i) Enzymatic synthesis of riboflavin glycosides; (ii) aminosugar metabolism; (iii) mechanism of ion transport; (iv) metabolism of carbohydrates in plants; and (v) biosynthesis of ascorbic acid.

14.3.2.5 A method has been developed to increase the tear and flex abrasion resistance of textiles by a process of built-in lubrication. Stearoyl chlorides, stearoyl ester of ethylene chlorohydrin and chloromethyl stearoyl ether have been used for this purpose and found to impart the expected multipurpose finish.

**14.3.3 GMRC —** The investigations pursued under this Committee cover a wide area in such specialized subjects such as sedimentation, palaeomagnetism, radiometric and geochemical observations, regional gravity and magnetic measurements and metalliferrous and other economic mineral deposits of the country. Out of these, ten schemes have a direct bearing on mineral economics and technology, that may prove of use to commerce and industry. Six schemes are concerned with bearing of ultramaffic magmas and relationship to the Upper Mantle.

**14.3.4 MRC —** In addition to the schemes in progress under this Committee eight research schemes on corrosion of metals were underway under different corrosion committees under the Corrosion Advisory Bureau. Atomospheric corrosion studies carried out in various parts of Gujarat have given valuable data on monthly and yearly corrosion rates. These data will be used along with those collected by the stations set up by the Defence Laboratory and CSIR Laboratory to draw up a Corrosion Map of India.

14.3.4.1 Research work carried out on corrosion has helped in the development of inhibitors from indigenous raw materials or protecting steel and aluminium in acid and alkali media. Work carried out at the Gujarat University on inhibition of copper and brass in various media has proved the suitability of different organic inhibitors.

**14.3.5 PDRC —** As many as 200 compounds received in the different screening centres have been preliminarily screened. Out of these, one compound has been found to possess significant anti-fungal activity (ringworm fungi), two against Ranikhat disease virus and one as an antisper-

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## Appendix 2

# NATIONAL LABORATORIES, DIRECTORATES/ORGANIZATIONS AND COOPERATIVE RESEARCH ASSOCIATIONS, THEIR HEADS AND FUNCTIONS

| *Laboratory/Address/Head* | *Functions* |
|---|---|
| **NCL** (Estd 1950)<br>Poona-8<br>Director: Dr B. D. Tilak | Fundamental and applied research covering the whole field of chemistry for which other specialized institutes have not been set up. The Laboratory is the custodian of National Collection of Type Cultures. |
| **NPL** (Estd 1950)<br>Hillside Road<br>New Delhi-12<br>Director: Dr A. R. Verma | Research in problems relating to physics, both fundamental and applied, maintenance of standards. Testing facilities are available. |
| **CFTRI** (Estd 1950)<br>Cheluvamba Mansion<br>P. O. V. V. Mohalla<br>Mysore<br>Director: Dr H. A. B. Parpia | Food processing and conservation of food, food engineering and all aspects of fruit technology. Regional fruit and vegetable preservation stations at Trichur, Nagpur, Bombay, Kodur, Simla, Jammu, Mangalore and Lucknow have been established. |
| **CFRI** (Estd 1950)<br>P. O. Jealgora<br>Dist Dhanbad<br>Director: Dr A. Lahiri | Fundamental and applied research on fuels—solid, liquid and gaseous. Physical and chemical surveys of Indian coals are conducted through seven coal survey stations under the Institute at Jealgora, Raniganj, Bilaspur, Ranchi, Jorhat, Nagpur and Jammu and two substations at Bisrampur (M.P.) and Singrauli (Ranchi). |
| **CGCRI** (Estd 1950)<br>Jadavpur<br>Calcutta-32<br>Scientist-in-Charge: Shri K. D. Sharma | Research on different aspects of glass and ceramics, pottery, porcelain, refractories and enamels; development of processes for manufacture of glass and ceramic articles; standardization of raw materials used in the ceramic industry. |
| **NML** (Estd 1950)<br>Burma Mines<br>Jamshedpur<br>Scientist-in-Charge: Dr T. Banerjee | Fundamental and applied metallurgical research relating to indigenous ores and mineral, refractories, ferrous and non-ferrous metals and alloys in relation to India's metal industries. The Laboratory has three Regional Foundry Stations functioning at Howrah, Madras, and Batala and a Corrosion Research Station at Digha (West Bengal). |
| **CDRI** (Estd 1951)<br>Chatter Manzil Palace<br>Lucknow<br>Director: Dr M. L. Dhar | All aspects of drug research including evaluation and standardization of crude drugs, discovery of substitutes for pharmacopoeial drugs and plants, pharmaceutical and synthetic chemicals, biochemistry and biophysics, infection, immunization, pharmacology, chemotherapy and experimental medicine. |
| **CRRI** (Estd 1952)<br>P. O. CRRI<br>Delhi-Mathura Road<br>New Delhi-20 | Research on design, construction and maintenance of roads, and on traffic problems and road safety; economic utilization of local resources for roads. |
| **CECRI** (Estd 1953)<br>CECRI Nagar P.O.<br>Karaikudi-3<br>(Madras State)<br>Director: Dr K. S. G. Doss | Research on different aspects of electrochemistry, including electro-metallurgy, electro-deposition and allied problems. The Institute has a Corrosion Testing Laboratory at Mandapam and a unit for demonstration of production of cryolite at Madras. |
| **CLRI** (Estd 1953)<br>Adayar<br>Madras-20<br>Director :Dr Y. Nayudamma | Fundamental and applied aspects of leather technology. The Institute has five Regional Extension Centres functioning at Calcutta, Bombay, Rajkot, Kanpur and Jullundur. |
| **CBRI** (Estd 1953)<br>Roorkee<br>Director: Prof. Dinesh Mohan | Research in soil mechanics and foundation engineering in relation to buildings and allied structures; building materials; building elements and operations; human comfort in relation to buildings; and architectural aspects of buildings. |
| **NBG** (Taken over in 1953)<br>Lucknow<br>Director: Dr L. B. Singh | Development of the medicinal plant resources of India, introduction and large-scale cultivation of economic and medicinal plants of industrial importance. |
| **CEERI** (Estd 1953)<br>Pilani<br>Director: Dr Amarjit Singh | Promotion of electronics research, particularly in fields of special purposes vacuum tubes, acoustics and audio engineering, electronic instrumentation, special electronic communications; and solid state devices. |
| **CSMCRI** (Estd 1954)<br>Waghavadi Road<br>Post Box No. 38<br>Bhavnagar<br>Director: Dr D. S. Datar | Investigations for improvement in the quality of salt required for various industrial purposes, recovery of important chemicals from seawater, extraction and utilization of by-products from marine and lake bitterns, recovery, production and utilization of various marine and allied chemicals, research on marine algae and its production. |
| **CMRS** (Estd 1955)<br>Barwa Road<br>Dhanbad<br>Director: Dr K. N. Sinha | Research in problems of efficiency, safety and health in mining operations, mine machinery and engineering. |
| **RRL Hyd.** (Taken over in 1956)<br>Uppal Road<br>Director: Dr G. S. Sidhu | Research in problems relating to the industries and raw materials of the region. Surveys and investigations on raw materials, processes techniques, and industrial products. Fields of research include fuels, vegetable oils, surface coatings, heavy chemicals and fertilizers, ceramics, organic chemicals, drugs and pharmaceuticals, chemical engineering and operational research. |
| **RRL Jammu** (Taken over in 1957)<br>Canal Road<br>Jammu-Tawi<br>Director: Dr K. Ganapathi | Research in problems relating to the industries and raw materials of the region and research specially directed to medicinal plants of the Himalayas (Kashmir region). The Laboratory has an Experimental Research Farm at Chatha (Jammu & Kashmir). |
| **RRL Jorhat** (Estd 1959)<br>Assam | Research in problems relating to more efficient utilization and better conservation of |

| *Laboratory/Address/Head* | *Functions* |
|---|---|
| **RRL Bhu.** (Under planning)<br>Orissa<br>Director: Shri G. S. Chowdhury | Research in problems relating to the industries and raw materials of the region. |
| **IIEM** (Taken over in 1956)<br>4, Raja S. C. Mullick Road<br>Calcutta-32<br>Director: Prof. R. B. Arora | Research in various aspects of biochemistry as applied to medicine, bacteriology etc. |
| **BITM** (Taken over in 1957)<br>19, Gurusaday Road<br>Calcutta-19<br>Curator-in-Charge: Shri S. K. Bagchi | A museum to depict scientific and technological advancement. |
| **CPHERI** (Estd 1958)<br>Wardha Road<br>Nagpur-3<br>Scientist-in-Charge:<br>Prof. M. V. Bopardikar | Research in all aspects of public health engineering and coordination of work of all interested agencies in this field in the country. Eight Field Centres of the Institute are functioning at Calcutta, Delhi, Bombay, Hyderabad, Ahmedabad, Kanpur, Jaipur and Bhopal. Besides, there are three field units at Borivli (Bombay), Jabalpur, Poona and an Enteric Virus Research Laboratory at Poona. |
| **CMERI** (Estd 1958)<br>Mahatma Gandhi Avenue<br>Durgapur-9<br>Director: Shri M. M. Suri | Research in mechanical engineering in all its aspects. |
| **CIMPO** (Estd 1958)<br>C/o National Botanic Gardens<br>Lucknow<br>Director: Dr K. Ganapathi | Coordination of activities in the development of cultivation and utilization of medicinal plants on organized basis. The Organization has two Zonal Centres, one at Bangalore and the other at Haldwani (UP). |
| **CSIO** (Estd 1959)<br>30 Bay Bldg, Sector 17<br>Chandigarh<br>Director: Dr P. S. Gill | Promotion and development of indigenous manufacture of scientific instruments for teaching, research and industry. There are two Service and Maintenance Units, one at New Delhi and the other at Madras. |
| **IIP** (Estd 1959)<br>Dehra Dun<br>Director: Dr M. G. Krishna | Research in petroleum refining and processing of natural gas, petrochemicals, etc. and providing facilities for the training of personnel for petroleum industry. |
| **NAL** (Estd 1960)<br>Jayamahal Road<br>Bangalore<br>Director: Dr S. R. Valluri | Scientific investigation of the problems of flight with a view to their practical application to design construction and operation of aircraft in India. |
| **NGRI** (Estd 1961)<br>Hyderabad-7<br>Director: Dr Hari Narain | Correlation of the field data in all fundamental aspects of geology and geophysics with laboratory investigations and theoretical studies. |
| **VITM** (Estd 1962)<br>Bangalore-1<br>Officer-in-Charge: Shri A. Bose | A museum to depict scientific and technological advancement. |
| **NIO** (Taken over in 1962)<br>B7, Hauz Khas<br>New Delhi-16<br>Director: Dr N. K. Panikkar | Research on various aspects of physical, biological, geological and chemical oceanography including prospecting for petroleum and minerals in sea bed. There are at present four units, Indian Ocean Biological Centre, Indian Ocean Physical Oceanography Centre, International Biological Programme functioning at Ernakulam (Kerala) and the Indian |

| *Laboratory/Address/Head* | *Functions* |
|---|---|
| **MSTM** (Under planning) | A museum to depict the scientific and technological advancement. |
| **SERC**<br>Roorkee<br>(U.P.)<br>Director: Prof. G. S. Ramaswamy | (i) To act as a clearing house for the latest knowledge and know-how relating to design and construction of bridges, buildings and other structures; (ii) to provide design consultancy services to organizations in the private and public sectors in developing complicated designs; (iii) to function as an advanced school of structural engineering research; (iv) to organize advanced courses in specialized aspects of structural engineering from time to time for the benefit of engineers drawn from the public and private sectors. |
| **ITRC**<br>C/o CDRI<br>Lucknow<br>Director: Dr S. H. Zaidi | To investigate the harmful effects of industrial toxins in skin, blood, gastrointestinal tract, central nervous system, bones, etc. and to study industrial dust radioactivity, physical aspects and environmental problems. |
| **Insdoc** (Estd 1952)<br>Hillside Road<br>New Delhi-12<br>Director: Shri B. S. Kesavan | To provide full range of documentation and translation services. |
| **PID** (Estd 1951)<br>Hillside Road<br>New Delhi-12<br>Scientist-in-Charge:<br>Shri S. B. Deshaprabhu | Collection and dissemination of scientific information. |
| **RSPO**<br>CSIR Secretariat, Rafi Marg<br>New Delhi-1<br>Scientist-in-Charge : Shri A. Rahman | To undertake research on problems of policy, planning organization of scientific research; to strengthen contacts and collaboration between scientific organizations and scientists in the country with those of other countries particularly the developing ones. |
| **CDEO**<br>CSIR Secretariat, Rafi Marg<br>New Delhi-1<br>Scientist-in-Charge: Dr K. S. Chari | To upscale the processes developed by the National Laboratories to commercial plants; to assist industry with designs and engineering services wherever the process is available; and to offer other services like feasibility and project reports, process engineering, engineering designs, etc. |
| **DSTP**<br>CSIR Secretariat, Rafi Marg<br>New Delhi-1<br>Scientist-in-Charge: Shri K. Ray | To maintain a National Register of scientists, technologists, engineers and medical personnel in the country and abroad; to act as a clearing house for information pertaining to availability and utilization of scientific and technical personnel; to conduct manpower research and special surveys on important problems, employment characteristics, utilization and wastage, inter-state mobility, estimation of manpower, etc. to operate the Scientists' Pool for temporary |

| *Laboratory/Address/Head* | *Functions* |
|---|---|
| **DRCIL**<br>CSIR Secretariat, Rafi Marg<br>New Delhi-1<br>Scientist-in-Charge: Shri Baldev Singh | To coordinate research programmes of the CSIR laboratories and institutes among themselves and also with other scientific and research organizations; to promote exploitation of indigenous know-how developed in the national laboratories; to organize Cooperative Research Associations; to identify the problems of user departments. |
| **ILU**<br>C/o PID, Hillside Road, New Delhi-12<br>Manager: Shri K. M. Agarwala | To collect and disseminate scientific and technical information by bringing out books, monographs, brochures, news bulletins, journals, reports etc. in Hindi and other Indian languages. |
| **DC Unit**<br>CSIR Secretariat, Rafi Marg<br>New Delhi-1<br>Scientist-in-Charge : Shri A. K. Bose | |
| **Patents Unit**<br>M-15, New Delhi South Extension Part I<br>New Delhi<br>Scientist-in-Charge: Shri R. B. Pai | |
| **Publicity & Information Unit**<br>CSIR Secretariat, Rafi Marg, New Delhi-1<br>Scientist : Shri P. L. Jaiswal | |

## Research Associations and their Heads

**ATIRA**
Director: Dr P. C. Mehta

**BTRA**
Director: Dr C. Nanjundayya

**SITRA**
Director: Shri K. Sreenivasan

**SASMIRA**
Executive Director : Shri J. G. Parikh

**IRMRA**
Hony Secretary & Treasurer:
Shri Lalit Mohan Jamnadas

**IPRA**
President: Shri P. C. Chanda

**IPIRA**
Director: Dr D. Narayanamurti

**CRII**
Dr H. C. Visvesvaraya

**TRA**
Director: Mr. D. H. Laycock

**WRA**
Deputy Director-in-Charge

**IJIRA**
Director of Research: Dr T. S. Subramanian

## Appendix 3

## EXPERIMENT/SURVEY STATIONS, FIELD CENTRES AND UNITS OF NATIONAL LABORATORIES

| *Laboratory/Field Unit/Address* | *Officer-in-Charge* |
|---|---|
| **NPL** | |
| Rain & Cloud Physics Research Unit<br>NPL Building, Hillside Road<br>New Delhi-12 | Dr Bh. V. Ramanamurthy |
| Radio Propagation Unit<br>Field Station Thumba<br>Equatorial Rocket Launching Site<br>Kerala State | |
| **CFTRI** | |
| CFTRI Experiment Station<br>Bhavan's College Campus, Andheri (West)<br>Bombay-58 | Shri G. R. Shah |
| CFTRI Experiment Station<br>Krishnadas Niwas, Shoranoor Road, Thiruvambadi<br>Trichur-1 | Shri K. K. Mookherji |
| CFTRI Experiment Station<br>Gole Bungalow, Nelson Square<br>Nagpur-1 | Shri O. P. Beerh |
| CFTRI Experiment Station<br>Pilot Plant Building of CDRI, Opp. High Court<br>Lucknow-1 | Shri N. K. Saha |
| CFTRI Experiment Station<br>Anantharajupet P. O.<br>Cuddapah Dist | Shri N. K. Srinath |
| CFTRI Experiment Station<br>Naubahar<br>Simla-2 | |
| CFTRI Experiment Station<br>C/o Regional Research Laboratory, Canal Road<br>Jammu-Tawi | |
| CFTRI Experiment Station<br>Fish Technology Experiment Station<br>Govt Ice Factory Building, Hoige Bazar<br>Mangalore-1 | Shri D. P. Sen |
| **CFRI** | |
| Jharia Coal Survey Station<br>P.O. Fuel Research Institute<br>Dhanbad, Bihar | Shri Sukumar Gupta |
| Raniganj Coal Survey Station<br>Bansra House<br>P. O. Raniganj (West Bengal) | Shri A. K. Mukherjee |

| *Laboratory/Field Unit/Address* | *Officer-in-Charge* |
|---|---|
| Coal Survey Laboratory<br>P. O. Namkum<br>Ranchi, Bihar | Shri K. C. Lahiri |
| Coal Survey Laboratory<br>P. O. Jorhat<br>Assam | Shri B. B. Baruah |
| Coal Survey Laboratory<br>17/C, Telenkedy Area, Civil Lines<br>Nagpur | Shri B. K. Sarin |
| Coal Survey Laboratory<br>Canal Road<br>Jammu-Tawi | Shri M. L. Beri |
| Coal Survey Field Laboratory<br>C/o Coal Survey Laboratory of CFRI<br>Bilaspur, Circuit House Road<br>P. O. Bilaspur (M.P.) | Shri K. K. Roy Chowdhury |
| Singrauli Sub-Station<br>C/o Coal Survey Laboratory of CFRI<br>P. O. Namkum, Ranchi | Shri D. K. Bhattacharya |
| **NML** | |
| Regional Foundry Station<br>Industrial Estate, Dassnagar<br>Howrah | Shri Ashmesh Dutt |
| Regional Foundry Station<br>Industrial Estate, Guindy<br>Madras-32 | Shri N. V. Naidu |
| Regional Foundry Station<br>Industrial Estate<br>Batala | Shri M. N. P. Verma |
| Marine Corrosion Research Station<br>Digha<br>Dist Midnapur | Shri K. P. Mukherjee |
| **CECRI** | |
| Corrosion Testing Laboratory of CECRI<br>C/o Central Marine Fisheries Research Institute<br>Mandapam Camp<br>Ramnathapuram District, Madras State | Shri V. Chandrasekharan |
| CECRI Madras Unit<br>C-21 Industrial Estate, Guindy<br>Madras-32 | Shri N. Balasubramanian |
| **CLRI** | |
| Regional Extension Centre CLRI<br>Calcutta | Shri J. C. Deb |
| Regional Extension Centre CLRI<br>Bombay | Shri W. N. Pandey |
| Regional Extension Centre CLRI<br>Rajkot | Dr T. J. Devassy |
| Regional Extension Centre CLRI<br>Jullundur | Shri N. Gupta |
| **CBRI** | |
| Regional Extension Centre<br>PWD Research Laboratory, PWD<br>Bhopal | Shri M. S. Srikantiah |
| CBRI Field Cell<br>C/o S.S.W., C.P.W.D.<br>Calcutta | Shri D. P. Sen Gupta |
| **NBG** | |
| Banthra Research Station<br>Banthra<br>Lucknow | Dr L. D. Kapur |
| Verinag Research Station<br>Verinag<br>Srinagar | Shri G. S. Srivastava |
| **RRL Jammu** | |
| Experimental Research Farm at Chatha<br>(J & K) | Dr P. K. Dutta |
| **CPHERI** | |
| CPHERI Zonal Centre<br>4th Floor of Premises No. 23<br>Rajendra Nath Mukherji Road<br>Calcutta-1 | Shri S. Rajagopalan |
| CPHERI Zonal Centre<br>Chandrawal Water Works No. II<br>Alipore Road<br>Delhi-6 | Shri J. S. Jain |
| CPHERI Zonal Centre<br>C/o Colaba Sewage Treatment Plant<br>Near Afgan Church, Colaba<br>Bombay-5 | Shri Y. S. Murthy |
| CPHERI Zonal Centre<br>Osmania Medical College, Sultan Bazar<br>Hyderabad-1 | Dr G. K. Seth |
| CPHERI Field Centre<br>Suburban Sub-Pumping Station<br>Sewage Farm Road<br>Ahmedabad | Shri M. V. Srinivasan |
| CPHERI Field Centre<br>6/33, Civil Lines<br>Kanpur | Shri R. N. Chakrabarty |
| CPHERI Field Centre<br>601-D, Type Quarters<br>Gandhi Nagar<br>Jaipur | Shri N. Dutta |

| *Laboratory/Field Unit/Address* | *Officer-in-Charge* |
|---|---|
| Enteric Virus Research Laboratory of CPHERI<br>Wadgaonsheri<br>Poona-14 | Shri S. H. Godbole |
| **CMERI** | |
| MERDO Centre<br>C/o National Chemical Laboratory<br>Poona-8 | Shri H. A. Siddiqi |
| MERDO Centre<br>C/o Guru Nanak Engineering College<br>Gill Road, Ludhiana<br>Punjab | Shri S. K. Banerjee |
| MERDO Centre<br>C/o College of Engineering, Guindy<br>Madras-32 | Dr S. Ramachandra |
| **CIMPO** | |
| Bangalore Zonal Centre<br>74, III Block, Jayanagar, Bangalore-2 | Dr K. V. Srinath |
| Haldwani Commercial Unit<br>Bhutia Parao, Haldwani (U.P.) | Shri B. C. Gulati |
| Jammu & Kashmir Commercial Unit<br>Zonal Office, Jammu | |
| Drug Research Laboratory<br>Jammu | Manager: Shri K. N. Kaul |
| Drug Farms<br>Jammu | Gen.Manager: Dr A. S. Sandhu |
| Drug Research Laboratory<br>Srinagar | Manager: Shri O.N. Channa |
| Drug Farms<br>Srinagar | Gen. Manager: Shri M. N. A. Khan |
| **CSIO** | |
| Service and Maintenance Unit<br>West Patel Nagar<br>New Delhi | Shri D. D. Puri |
| Regional Service Centre<br>C/o CLRI, Madras | Shri U. H. Narayanan |
| IIP Project Division<br>A-9 Ring Road, Lajpat Nagar III<br>New Delhi-14 | Dr J. S. Ahluwalia |
| **NIO** | |
| Indian Ocean Data Centre<br>B-7, Hauz Khas Enclave<br>New Delhi-16 | Shri R. Jayaraman |
| Indian Ocean Biological Centre | |

| *Laboratory/Field Unit/Address* | *Officer-in-Charge* |
|---|---|
| Indian Ocean Physical Oceanography<br>Centre, Karikkamuri Road<br>Ernakulam-1 | Dr V. V. R. Varadachari |
| International Biological Programme Unit<br>Karikkamuri Cross Road<br>Ernakulam | Dr S. Z. Quasim |
| Liaison & Training Programme Unit<br>Hornbill House<br>Bombay-1 | Dr T. S. Satyanarayana Rao |
| **Insdoc** | |
| Insdoc Regional Centre<br>Indian Institute of Science<br>Bangalore | Shri K. S. Nagarajan |

## Appendix 4

# EXECUTIVE COUNCILS AND OTHER COMMITTEES

## Executive Councils

### NCL

*Chairman*

Shri Arvind N. Mafatlal
Mafatlal House, Backbay Reclamation Bombay

*Members*

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Director, CIBA Research Centre, Goregaon Bombay

Dr D. K. Banerjee
Professor of Organic Chemistry, Indian Institute of Science, Bangalore

Prof. Santi R. Palit
Professor of Physical Chemistry
Indian Association for the Cultivation of Science, Jadavpur, Calcutta

Prof. R. C. Mehrotra
Dean, Faculty of Science, Rajasthan University, Jaipur

Dr W. D. Patwardhan
Director, HQ-Explosive Research Development Laboratory, Kirkee, Poona

Dr G. P. Kane
Officer-on-Special Duty, Ministry of Industry, New Delhi

Dr T. R. Seshadri, F. R. S.
Emeritus Professor, University of Delhi Delhi

Dr H. E. Eduljee
National Peroxide Ltd, Naville House Graham Road, Ballard Estate, Bombay

Prof. B. K. Bachhawat
Professor of Biochemistry, Department of Neurology, Neurosurgery & Neurochemistry, Christian Medical College & Hospital Vellore, Madras State

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, NCL, Poona

### NPL

*Chairman*

*Members*

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Professor of Physics, University of Mysore Mysore

Dr A. K. Saha
Saha Institute of Nuclear Physics, 92, Acharya Prafulla Chandra Road, Calcutta

Dr D. S. Kothari
Chairman, University Grants Commission Bahadur Shah Zafar Marg, New Delhi

Prof. R. C. Majumdar
Head of the Department of Physics & Astrophysics, University of Delhi, Delhi

Shri R. K. Gejji
Industrial Adviser (Engineering), Directorate General of Technical Development, New Delhi

Dr A. N. Ghosh
Director-General, Indian Standards Institution, New Delhi

Dr Kartar Singh
Director, Defence Science Laboratory Delhi

Dr G. N. Ramachandran
Head of the Department of Physics University of Madras, Madras

Dr R. K. Asundi
Spectroscopy Division, Atomic Energy Establishment Trombay, Bombay

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, NPL, New Delhi

### CFTRI

*Chairman*

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River View, Adyar
Madras

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Hindustan Lever Ltd, Bombay

Dr V. Ranganathan
Deputy Chief Scientist, Defence Research & Development Organization, New Delhi

Shri N. Srinivasan
Industrial Adviser (Chemicals), Directorate General of Technical Development New Delhi

Dr C. Gopalan
Director, Nutrition Research Laboratories Hyderabad

Dr B. P. Pal
Director-General, Indian Council of Agricultural Research, New Delhi

Shri K. T. Chandy
Chairman, Food Corporation of India Madras

Shri K. U. Patel
Tims Products, 15 India Exchange Place Calcutta

Dr D. V. Rege
Professor of Food Technology, Department of Chemical Technology, University of Bombay, Bombay

Shri B. B. Sardeshpande
Corn Products Co. (India) Pvt. Ltd, Woudby Road, Bombay

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, CFTRI, Mysore

### CFRI

*Chairman*

Shri J. J. Ghandy
Resident Director, Tata Iron & Steel Co. Ltd, Jamshedpur

*Members*

Shri S. K. Nargundkar
Chairman & Managing Director, National Coal Development Corporation Ltd, Ranchi

Shri A. C. Bose
Chairman, Coal Board, 1, Council House Street, Calcutta

Shri R. P. Sinha
Chief Engineer, Hindustan Steel Ltd, Ranchi

Shri K. N. Subbaraman

Shri A. K. Ghose
Member (Thermal), Central Water & Power Commission, (Power Wing) New Delhi

Shri M. A. Rao
Former Member (Engineering), Ministry of Railways,
C/o Railway Board, New Delhi

Dr M. N. Rao
Professor & Head of the Department of Chemical Engineering, Indian Institute of Technology, Kharagpur

Shri Bhaskar Mitter
Managing Director, Andrew Yu'e & Co. Ltd, Calcutta

Shri Pran Prashad
Chairman, The Bird-Heilgers Group Chartered Bank Building, Calcutta

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, CFRI, Jealgora

### CGCRI

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Director, Bose Institute, 93/1, A. P. Chandra Road, Calcutta

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Technical Director, Parshuram Pottery Works Co. Ltd, Wankaner

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Director, Instruments Research & Development Establishment, Dehra Dun

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Borosil Glass Works Ltd, Chotani Estates Bombay

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Industrial Adviser (Chemicals), Directorate General of Technical Development New Delhi

Dr S. S. Ghosh
Refractory Engineer, Hindustan Steel Ltd Bhilai Steel Plant, Bhilai

Dr H. K. Mitra
P-16/1B, Keyatala Lane, Calcutta

Prof. P. K. Kichlu
5/A, Maharani Bagh, New Delhi

Dr G. C. Chatterjee
Director-General, Geological Survey of India
Calcutta

Shri L. R. Bhagat
Sodepore Potteries Pvt. Ltd, Sodepore
24, Parganas, West Bengal

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, CGCRI, Calcutta

**NML**

*Chairman*

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India Steamship House, 21, Old Court House
Street, Calcutta

*Members*

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Resident Director, Tata Iron & Steel Co.
Ltd, Jamshedpur

Shri P. R. Kamani
Managing Director, Kamani Metals &
Alloys Ltd, Bombay

Prof. T. R. Anantharaman
Professor & Head of the Department of
Metallurgy, Banaras Hindu University
Varanasi

Shri R. L. Khanna
Indian Copper Corporation Ltd, Ghatsila
Bihar

Dr G. P. Chatterjee
Chief Metallurgist, Durgapur Steel Plant
Durgapur

Dr Brahm Prakash
Director, Metallurgy Group, Atomic Energy
Establishment, Trombay, Bombay

Shri A. L. Saberwal
General Manager, Indian Aluminium Co.
Ltd, Calcutta

Dr R. V. Tamhankar
Director, Defence Metallurgical Research
Laboratory, Hyderabad

Shri M. Krishnaswamy
Industrial Adviser (Engg), Directorate
General of Technical Development, New
Delhi

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Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, NML, Jamshedpur

**CDRI & ITRC**

*Chairman*

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*Members*

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Bombay House, Bombay

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Professor of Pharmacology, Department of
Pharmacology, Seth G. S. Medical College
Bombay

Prof. R. V. Singh
Principal, King George's Medical College
University of Lucknow, Lucknow

Dr J. B. Shrivastav
Director, National Institute of Communicable
Diseases, Delhi

Dr K. N. Rao
Director-General of Health Services, Govt of
India, New Delhi

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Managing Director, Unichem Laboratories
Ltd, Bombay

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Director, Bengal Immunity Research
Institute, Calcutta

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Director-General, Armed Forces Medical
Services, New Delhi

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Drug Controller, Directorate General of
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Financial Adviser to CSIR, New Delhi

Director, Institute/Centre

**CRRI**

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Director-General (Road Development) &
Additional Secretary to Government of India
Ministry of Transport and Aviation
New Delhi

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Adviser (Construction ), Planning Commis-
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Chief Engineer & Joint Secretary, Buildings

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Chief Engineer, P.W.D. (B & R), Jaipur

Dr B. R. Sen
Professor in Civil Engineering, Indian
Institute of Technology, Kharagpur

Maj. Gen. R. A. Loomba
Director-General, Border Roads, New Delhi

Chief Engineer,
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Additional Chief Engineer
Civil Aviation, New Delhi
(Shri D. N. Endlaw)

Director
Institute of Road Transport, Ministry of
Transport & Aviation

Director-General
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Financial Adviser to CSIR, New Delhi

Director, CRRI, New Delhi

**CECRI**

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Vice-Chancellor, University of Madras
Madras

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Director-in-Charge, Tata Chemicals Ltd
Fort, Bombay

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Department of Chemical Engineering
Indian Institute of Science, Bangalore

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Joint Director, Research Designs & Standards
Organization, Chittaranjan

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Development Officer (Alkalis)
Directorate General of Technical Develop-
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Deputy Chief Scientist, Defence Research
& Development Organization, Ministry of
Defence, New Delhi

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Director, Sheila Dhar Institute of Soil
Science, University of Allahabad, Allahabad

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Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, CECRI, Karaikudi

**CLRI**

*Chairman*

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Managing Director, The India Leather
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Vice-Chancellor, University of Madras
Madras

The President of the Tanner's Federation
of India, Chamber of Commerce Building
Kanpur

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Bata Shoe Co. (P) Ltd, Calcutta

Shri P. R. Sondhi
Kapurthala Northern India Tanneries Ltd
Kapurthala

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Industrial Adviser (Chemicals), Directorate
General of Technical Development
New Delhi

Shri Sanjoy Sen
National Tannery Co. Ltd, Lall Bazar
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Director, Department of Defence Production,
Ministry of Defence, New Delhi

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Industries, Ministry of Industry, New Delhi

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Professor of Chemistry, Delhi University
Delhi

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**CBRI & SERC**

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Architect, 14-F, Central Ring, Connaught Place, New Delhi

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Shri F. B. Pithavadian
Prynne Abbott & Davis, 13, College Road Madras

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Financial Adviser to CSIR, New Delhi

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**NBG**

*Chairman*

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Director, Botanical Survey of India, Calcutta

*Members*

Dr K. Biswas
P-19, Old Ballygunge Road, Ballygunge Calcutta

Dr K. A. Chaudhary
Head of the Department of Botany, Aligarh Muslim University, Aligarh

Dr J. C. Sen Gupta
President, West Bengal Board of Secondary Education, Calcutta

Prof. T. S. Sadasivan
Director, University Botany Laboratory University of Madras, Madras

Dr M. H. Mari Gowda
Director of Horticulture, Department of Horticulture, Bangalore

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

Director, NBG, Lucknow

**CEERI**

*Chairman*

Shri B. V. Baliga
Managing Director, Bharat Electronics Ltd, Bangalore

*Members*

Brig. B. J. Shahanoy
Director Designate, Electronics Research & Development Establishment, Bangalore

Dr A. S. Rao
Director, Electronics Group, Atomic Energy Establishment Trombay, Bombay

Shri C. P. Vasudevan
Member, Research, P&T Board, New Delhi

Shri P. N. Deobhakta
Development Officer (Electronics), Directorate General of Technical Development New Delhi

Shri C. Subramaniam
Deputy General Manager (Components Division), Bharat Electronics Ltd, Bangalore

Shri S. S. Aiyar
Chief Engineer, Office of the Director-General, All India Radio, New Delhi

Shri G. R. S. Rao
General Manager (Works), The National Ecko Radio & Engineering Co. Ltd, Bombay

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Director, Solid State Physics Laboratory Ministry of Defence, Delhi

Prof. S. Sampath
Deputy Director, Indian Institute of Technology, Madras

Financial Adviser to CSIR
New Delhi

Director, CEERI, Pilani

**CSMCRI**

*Chairman*

Dr Jivraj N. Mehta
73, Bharati Nagar
New Delhi

*Members*

Maj. Gen. M. S. Himatsinghji
D 16/E, Hauz Khas Enclave
New Delhi

Shri Darbari S. Seth
Director-in-Charge, Tata Chemicals Ltd Bombay

Shri G. T. Kamdar
Managing Director, Bhavnagar Salt & Industrial Works Ltd, Bhavnagar

Shri J. C. Maheshwari
Development Officer, (Acids & Fertilizers) Directorate General of Technical Development, New Delhi

Prof. T. V. Desikachari
Professor of Botany, University Botany Laboratory, Madras

Salt Commissioner
Government of India, Jaipur
(Shri D. R. Sundaram)

Dr R. P. Mitra
Head of the Department of Chemistry University of Delhi, Delhi

Dr J. V. S. R. Anjaneyulu
Director, Defence Laboratory, Jodhpur

Director-General
Scientific & Industrial Research, New Delhi

Financial Adviser to CSIR, New Delhi

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|---|---|
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| | Evaluation of the container and substitute lacquers and sealing compounds for packing food products |
| CFTRI & RRL Jorhat | Protein synthesis from petroleum |
| CFRI & NML | Supply of semi-coke for trials in low shaft furnace pilot plant for production of pig iron |
| NML & CDEO | Setting up a pilot plant for the production of magnesium at Jamshedpur |
| CRRI & RRL Jorhat | Prevention of moss formation in plastered walls |
| CECRI & CMRS | Accelerated life test on caplamp batteries at the instance of Indian Standards Institution |
| CECRI & Insdoc | Electrostatic paper |
| CLRI & RRL Hyd. | Preparation of syntans |
| CLRI & RRL Jorhat | Utilization of spent tanning materials |
| CPHERI & IIP | Bacteriological cultivation of aviation turbine fuel |
| CMERI & CRRI | Indigenous manufacture of road making machinery |
| VITM & CFTRI | Arrangement of a temporary exhibition for 6 months on 'Preservation and storage of food and pest control measures' at the Museum |
| VITM & BITM | Setting up a 'Sample Science Museum' at the National Stadium on the eve of Unesco Regional Seminar and exchange of films and exhibits |

## Appendix 6

## COLLABORATION OF NATIONAL LABORATORIES WITH RESEARCH INSTITUTES, INDUSTRY AND ORGANIZATIONS OUTSIDE CSIR

| *Laboratory & Collaborating Organization(s)* | *Project* |
|---|---|
| CFRI, Geological Survey & Coal Board | Quality assessment of resources of coal |
| CFRI, Geological Survey & National Coal Development Corporation | Logging and sampling of exploratory bore hole coal cores for quality assessment |
| NML & Indian Institute of Foundrymen | Organizing Third International Foundry Congress |
| CRRI & Metropolitan Planning Organization, Calcutta | Greater Calcutta Plan |
| CRRI & Govt of Mysore | Master Plan for Bangalore Metropolitan area |
| CRRI & IJRRA | Use of jute nets for erosion control on embankment and hillside slopes |
| CECRI & Defence Research Development Laboratory, Hyderabad | Development of silver oxide-zinc power pack |
| CECRI & Defence Research Laboratory (Materials), Kanpur | Comparative corrosion resistance of various priming paints used for mild steel surfaces at Mandapam camp |
| CMRS, National Coal Development Corporation, Coal Board & Chief Inspector of Mines | Suitability of pneumatic stowing |
| CMRS, Rajendra Memorial Research Institute of Medical Sciences, Patna Central Hospital, Dhanbad | Survey of respiratory morbidity and pneumoconiosis among workers in Jharia coalfied |
| RRL Hyd. & National Research Laboratories, Hyderabad | Effect of edible cottonseed flour on human nutrition |
| RRL Hyd. & Hindustan Lever Ltd | Development of new packaged consumer food products |
| RRL Hyd. & Defence Research Organization | Microferrites, insulating materials for rocket chambers, silicon nitride, anti-corrosive paints for ship bottoms and colloidal graphite |
| RRL Jorhat & National Buildings Organization | Comparative study of flat roof specifications |
| RRL Jorhat & Assam Oil Co. | Analysis of low wax and high wax crude for detection of viable microorganisms |
| IIEM, Bose Research Institute & Tata Memorial Hospital, Bombay | Correlation between cancer and other metabolic diseases and screening of antitumour drug |
| IIEM & Bhabha Research Centre, Bombay | Biogenesis of alkaloids |
| IIEM & Directorate-General of Health Services | Cholera control |
| CPHERI & National Institute of Communicable Diseases, Delhi | Survival of cholera vibrio in well waters |
| IIP, Indian Institute of Technology & Indian Oil Corporation | Use of naphtha as fuel in cement kilns and power plant |

## Appendix 7

## COLLABORATION OF NATIONAL LABORATORIES WITH UNIVERSITIES IN RESEARCH AND LECTURE PROGRAMMES

| *Laboratory* | *Field of Collaboration* |
|---|---|
| | **Research** |
| NCL | (i) Microanalysis of samples; (ii) Instrumental analytical work such as IR, UV, X-ray diffraction patterns, NMR spectra, (iii) Supply of different bacteria yeast and fungi cultures, free of charge |
| CECRI | Research in 'Polarography of pyrimidinic compounds' by a lecturer in chemistry, Jodhpur University; Research on 'Chronoamperometry and double layer capacity measurements' by Delhi University candidates |
| NBG | 'Study of effects of different sowing times on the flower-type of a particular strain of Balsam' with Faculty of Agriculture, University of Tokyo, Tokyo |
| CSMCRI | Facilities for a research worker from Bombay University for work in marine algae |
| RRL Jammu | On the study of *Crotalaria* species in collaboration with CSIRO, Australia |
| IIEM | On biochemical mechanism of the antitumour property and antiviral effect of the fungal pigment Jawaharene, with Biochemistry Department of Calcutta University, Pharmacy Department of Jadavpur University & Indian Cancer Research Centre, Bombay |
| | On preparation of human pituitary gonadotropic hormone and assay of its activity with Calcutta Medical College, Calcutta |
| CIMPO | With University of Agricultural Sciences, Bangalore in finding out a solution of nematode problem in patchouli; with U. P. Agricultural University on a number of problems for mutual assistance and remedial measure |
| CSIO | Fabrication of equipment for Panjab and Kurukshetra Universities and Meerut College |
| NAL | With Indian Institute of Science on the exploitation of Sirius computer programmes for load flow, short circuit studies and network analysis |
| | Experimental work on shells with Bangalore University |
| | **Lectures** |
| NCL | Lectures on different subjects at various universities by twenty scientists |
| CFTRI | Lectures and training to B. Sc. students from Maharani's College, Mysore on fruit preservation |
| CGCRI | Four scientists served as honorary lecturers in various universities and institutions |
| CDRI | Lectures at the Dental College, Lucknow, Department of Chemistry, Lucknow University, Lucknow by scientists of the Institute |
| CRRI | Case histories of certain difficult foundation projects at the Indian Institute of Technology, New Delhi |
| CLRI | Lecture by Dr M. Santhappa of Madras University on 'Properties of polymers'; by Dr M. M. Bokadia of Vikram University on 'Chemistry of Vegetable tannins; by Dr B. S. Thiagarajan of Madras University on 'Mechanism of molecular migration' |
| RRL Hyd. | Lectures on (i) Oils & fats, (ii) Paints & varnishes to M. Tech. students of Osmania University |
| IIEM | Three scientists associated with post-graduate teaching of Calcutta University |
| CSIO | Lectures by Director at the summer schools of (i) Department of Physics, Panjab University, (ii) Central Polytechnic, Chandigarh on 'Achievement |

## Appendix 8

## INTERNATIONAL COLLABORATION

| *Laboratory* | *Field of Collaboration* |
|---|---|
| NCL | Work on three research projects has been carried out with the collaboration of the US Department of Agriculture under P. L. 480 scheme and one project with the National Bureau of Standards, Washington |
| CFRI | Petrographic studies on Commonwealth coals were continued for exchange of information and standardization of data among various laboratories of the Commonwealth countries |
| | The headquarters of the Indian Section of the Institute of Fuel, UK are situated at CFRI |
| CGCRI | One nominee from UAR underwent training in 'Properties of optical glass' for about a year under Indo-UAR agreement |
| CLRI | Prof. D. S. Jackson of Manchester University, UK, worked as a Colombo Plan Expert (July 7 to Sept. 23, 1966). At his instance project on 'Role of N-Collagen components on tanning' has been taken up for investigation |
| | Dr Ernest Gergely of Yugoslavia, UN Tannery Expert, worked under UNTA programme (Aug. 30 to Sept. 19, 1966) |
| | A scholar from Thailand has completed his training in 'Leather manufacture |
| NBG | University of Florida, USA has agreed to supply rare and costly chemicals, seeds and equipment for the virology laboratory of NBG especially for virus research in *Citrus* and ornamental plants. |
| RRL Hyd. | An agency for international trade of Yugoslavia, *Jugo Import* is collaborating for setting up a plant for chemical cotton manufacture from cotton linter of Yugoslavia based on the process developed at the Laboratory |
| CPHERI | Prof. J. C. Morris, WHO short-term consultant, visited during Sept.-Oct. 1966 for finalizing Report of WHO Project No. India-176 |
| | Doz. Dr Hartmut Bick (Zoologisches Institute, University of Bonn, West Germany), a WHO Scientific Consultant visited the Institute (Oct. 17 to Nov. 14, 1966) to advise on 'Biological characteristics of water quality' and to initiate trials on Saprobian System in India adopting Central European techniques |
| CMERI | Dr Paul Greguss (Jr) Expert in application of ultrasonics joined the Institute on Dec. 13, 1966 to work for six months under Indo-Hungarian Cultural Exchange Programme |
| | Dr T. G. J. Glinn, metallurgical engineer, joined on Dec. 15, 1966 to work for 2 years under Colombo Plan |
| CSIO | Sarvashri R. Nussbauner and Paul F. Lienert, Swiss Experts, joined the Indo-Swiss Training Centre on Aug. 24, 1966 |
| NGRI | The Institute is participating in the following International Programmes: International Quiet Sun Year; World Magnetic Survey; Upper Mantle Project; and International Hydrological Decade |

## Appendix 9

# TECHNICAL AID RENDERED BY NATIONAL LABORATORIES

| *Laboratory* | *Nature of Aid* |
|---|---|
| NCL | Demonstrations of many processes developed; scientists visit industries for general follow-up and liaison work; analysis of chemicals and fabrication of equipment |
| CFTRI | Demonstrations of processes such as pest control techniques, preparation of fruitbars, preservation of shell eggs, common recipes using MPF, fruit and vegetable preservation; Technical advice on contact fumigation, Durofume process, storage of foodgrains, peanut flour production, suitability of certain lacquers for canning fish, quality control in chicory, packaging, production of soup powders, manufacture of cashew apple wine, improvements in parboiling, preparation of project engineering reports for production of egg powder, installation of dehydration plant, equipment layout of bakers' yeast plant; report on quality of Indian milled flour, packaging materials, report on technical feasibility of different types of extracting units in rice mills |
| CFRI | Extension work on (i) acceptable tests of coal washery and assistance to *Hindustan Steel Ltd* in commissioning Patherdih coal washing plant; manufacture of metallurgical coke from Kanhan Valley coals for a pig iron complex at the request of Maharashtra Government; and on performance of Bhojudih coal washing plant; Extension and practical demonstration to National Coal Development Corporation in respect of (i) drawing of bulk samples of Ramgarh VII Top and Bottom seams for coal carbonization tests; (ii) sampling of Bermo and Karo seam coals for quality assessment, and (iii) methods of collection of samples at Bhojudih coal washery for testing; Technical assistance to *Hindustan Steels Ltd* in regard to correlation between volatile matter content and shatter index of coke; National Coal Development Corporation in respect of analysis and box coking tests of samples from Pundi Block, Monidih colliery, Ramgarh Block II, Karo Block; preparation and servicing of bore hole coal core samples, report on Sudamdih Washery project on Bermo seam coal cores of Sawang and Govindpur Blocks and on coals of Karo Group; Furnishing reports on production of hardbords to many parties; Discussion with Assam Government authorities on utilization of Margherita and Garo Hills coals, with Government of Bihar on Ramgarh Industrial complex, with *Bokaro Steel Ltd* on suitability and quality of coals for manufacture of coke used in tall blast furnace and on production of strong coke of quaternary blend; Notes on manufacture of briquettes and moulded shapes from slack coal or coke breeze; continuous devolatilization of low-grade non-caking coals on moving bed, utilization of indigenous amphibole variety of asbestos for production of asbestos cement sheets, sources of supply of coals for generating electricity at Santaldih, etc. |
| CGCRI | Extension work on fuel efficiency of glass melting tank furnaces at a particular factory; Demonstration trials of high temperature protective enamels for use in jet aircraft exhaust systems |
| | Technical assistance to industry and government organizations on improving quality of glass and ceramic products and increasing their productivity and production |
| NML | Practical demonstrations of some processes developed by the Laboratory to the licensees; Detailed technical notes prepared on some projects made through enquiries |
| | Over 100 short-term investigations and specification tests on behalf of private and public sectors |
| CRRI | Technical advice to States in road development projects; |
| | Technical supervision of construction of (i) stabilized soil road in Ganganagar dist. (Rajasthan); (ii) road on black cotton soil near Sehore (M.P.); (iii) stabilization of black cotton soil and moorum with lime near Hyderabad; construction of soil gravel road near Bangalore, of roads between Bangra-Gopalpura, Majhwara-Malipur, Anola-Siroli and Pallaia-Nighson (U.P.) using locally available materials, of roads between Akaltara-Pangarh, Berasia-Shamshabad, Sehore-Bilquishganj and Baragaon-Sibonia (M.P.), of approach road to Tungabhadra Project at Harihar and from Kottur to Banial (Mysore); |
| | Survey of locally available materials in A.P., Gujarat, M.P., Maharashtra, Mysore, Rajasthan for extending the Institute techniques of road construction and also of soils; |
| | Practical demonstration of the process of reactive surkhi and of lime-reactive surkhi mixture to many interested firms and of use of bump integrator for Maharashtra PWD; Preparation of specifications and code of practice for construction of concrete airfield pavements; Measurement of riding quality of runway pavements of airfields; |
| | Determination of unevenness index of roads in Maharashtra; Analysis and recommendations concerning corrective measures for certain landslides in Sikkim and Kashmir for the Border Roads Organization |
| CECRI | Processes of producing electrolytic iron powder, vapour phase inhibitors, misch metal, calcium gluconate, *p*-aminophenol, benzidine and lithoplate demonstrated to the parties to whom they have been leased |
| CLRI | Advice to tanners on manufacture of tannin extracts from goran, starting new tanners in Calcutta, manufacture of glue from buffalo hide cuttings and of returned chrome leathers using lac, use of CLRI adhesives for belting leather manufacture and tanning of crocodile skin; |
| | Analytical reports to industry on samples of leather, water and leather auxiliaries |
| CBRI | Extension work on building prefabricated timber huts based on CBRI designs and specifications by the Army Headquarters; Demonstration of the following processes: use of under-reamed pile foundations for a three-storeyed house, and D. C. tile roof and cellular roofing developed by the Institute |
| NBG | Collaboration with U.P. Government Department of Agriculture in Grow More Vegetable Campaign by raising seedlings of onion, tomato, and supplying for free distribution to public; Technical advice regarding layout of gardens, cultivation and propagation of ornamental plants, laying out of orchards, etc. |
| CEERI | Practical training to engineers of a firm to whom the process on manufacture of television receivers is licensed; |
| | Assistance to firms regarding manufacture of electronic flash tubes, digital frequency meter and R.F. signal generator, and testing of transponder |
| CSMCRI | Project circulars and non-technical notes on the completed processes to prospective entrepreneurs; Processes of production of mixed salt for use in making potassium schoenite, stabilization of soils in pans for use of mechanical harvester and desalination of seawater by solar stills and H.D. units explained to salt works and interested parties; |
| | Survey of brines of salt works in Little Rann of Kutch at Kharagoda for possible production of carnalite and kainite carried out; Experiments carried out on polythene lining of crystallizer beds at Shiroda Salt Works to reduce brine percolation; |
| | Demonstration of the following processes to interested parties: Plaster of paris bandages, potassium schoenite, bromine, ethylene dibromide, dese- |

| *Laboratory* | *Nature of Aid* |
|---|---|
| CMRS | Testing of (i) Indian and foreign-made flame-proof electrical equipment, (ii) suitability of Indian-made electric-resistance-welded conduit for use in flame-proof installations in lieu of solid drawn conduits; (iii) dust-tight, dust-proof fittings; (iv) lighting fittings and lamp fittings for defence purposes; (v) explosive compositions for inclusion in permitted list; (vi) Group $P_3$ compositions; (vii) instantaneous electric detonators for safety in fire-damp; (viii) Indian-made multi-shot exploder; (ix) indigenous batteries; (x) Indian-made PVC shot firing cable; (xi) conveyor betting of UK origin for use in mines; (xii) ventilation ducting; (xiii) miner's safety lamps and components, safety helmets (xiv) methanometer calibration; |
| | Analysis of mine air mine dust, stone dust, etc, for industry and Government departments; |
| | Facilities provided to industry for destructive and proof-load testing and non-destructive testing of mine equipment |
| RRL Hyd. | Processes of production of benzyl chloride, barium potassium chromate and terpineol and terpine hydrate demonstrated to concerned parties; Helping firms in (i) distillation of cashewnut shell liquid, (ii) production of Korvi Fuller's earth and standardization of process and quality control; |
| | Advice to a firm on improving efficiency of quality of acetic anhydride produced; Design and commission of a stripping column for a firm; |
| | Preparation of a feasibility report for production of terpineol from carene and demonstration of the process to a firm |
| RRL Jammu | Demonstration and practical training in isolation of menthol thymol and other essential oil isolates and general analysis of essential oils to a firm; |
| | Note on problems relating to the food industries of Jammu and Kashmir State for the Director of Industries and Commerce; |
| | Visit to fruit preservation units in Kashmir Valley for on-spot guidance to them. |
| RRL Jorhat | Demonstration of prototype 50 kg./hr vertical kiln cement plant and of the process of manufacture of particle boards from agro-industrial wastes to interested parties; Assistance to a paper mill in method of pulping waste paper from Government Security Press, Nasik |
| CPHERI | Plan for assessment of air pollution in Calcutta metropolis; |
| | Survey of air pollution within the pressure of a chemical and fertilizer factory; Fortnightly survey of the quality of air at Wardha for a forge foundry factory; proper treatment and disposal of effluents from strawboard factories from caustic soda, chlorine and hydrochloric acid plants, industrial waste treatment and disposal and stream pollution in U.P.; |
| | Problem of water supply in Bareilly; Regular bacteriological analysis of water samples; |
| | Help in designing and operation of an oxidation pond from treatment of sewage at Babina; Starting of a Sanitation Workshop for training of sanitary inspectors in rural sanitation |
| BITM | Lecture demonstrations in the Museum on subjects from school syllabus and outside; Creative Ability Centre for school students at the Museum; Science Exhibition for children at the museum |
| CMERI | Advice on design and development of an axial flow fan, design modification of rice and wheat thresher, design and fabrication of horizontal model fatigue test rig for steering columns; Verification of a gear pump design; |
| | ... welds which are diffi- |

| *Laboratory* | *Nature of Aid* |
|---|---|
| CSIO | Demonstration of performance of instruments developed; Practical service like designing and fabrication of optics, curve generating, centering and edging, polishing and blowing offered to industry on payment; Testing, measurement of lenses and lens systems received from industry; Assistance in development of specialized instruments to Development Centres; Repairing of scientific instruments for industries and research organizations |
| IIP | Data on petroleum products consumption and forecast of demand, on future demand for acrylic acid esters, on future requirements of naphtha for fertilizers, on throughput of products through Cochin-Coimbatore pipeline; Information on instruments normally used in petroleum refinery and petrochemical plants, utilization of refinery gases ex-Gauhati refinery, adulteration of HSDO with kerosene, emission spectrograph and its application in lubricating oil studies, testing of aircraft turbine oil and formulating hydraulic brake fluids |
| NAL | Technical consultancy service to 15 organizations |
| NGRI | Groundwater surveys in and around Hyderabad district to raise agricultural output |
| SERC | Theoretical analysis and experimental investigation on a 1/10 scale model of Shaheed Bhagat Singh, Raj Guru and Sukh Dev memorial; Guidance in analysis, design and construction of folded plates; |
| | Analysis, design and reinforcement drawings of folded plate roofs; |
| | Analysis and computation of member sizes and reinforcement for cavitation laboratory building |
| | Photoelastic analysis of mill end |
| | Preliminary designs and approximate cost estimates for funicular shells for grain godowns |
| | Supply of alternative designs and help in selecting final design for platform roof at Saranath railway station and scrutiny of available designs, supply of alternative designs and preliminary estimates for folded plate type gauges |

## Appendix 10

# PATENT APPLICATIONS FILED, ACCEPTED AND SEALED IN INDIA AND FOREIGN COUNTRIES

(JANUARY TO DECEMBER 1966)

INDIA

### Applications Filed

**NCL**

106804 Improvement related to the manufacture of carboxy methyl cellulose — D. S. Bendale, M. B. Mahajan & H. P. Khadilkar

106808 Improvements in or relating to the preparation of mixed oxide ceramic compositions — M. N. S. Murthy & K. P. B. Sinha

108413 A process for treatment of costus roots (*Saussurea lappa* Clarke) for isolation of inulin — G. H. Kulkarni, G. R. Kelkar, J. L. Bose & S. C. Bhattacharyya

108414 A process for treatment of costus roots (*Saussurea lappa*) or inulin isolated therefrom for the production of fructose — G. H. Kulkarni, G. R. Kelkar, J. L. Bose & S. C. Bhattacharyya

**NPL**

104844 Conducting silver paint — C. V. Ganapathy & S. M. Khular

104970 Dielectric-loaded waveguide type broad bank E-plane ferrite resonance isolators for microwave frequencies — K. Chandra, Ram Parshad & V. K. Agrawal

105896 Improvements in the manufacture of high permeability manganese zinc ferrites — T. V. Ramamurti, C. V. Ganapathy, R. Krishnan, S. C. Gupta, R. S. Khanduja, S. S. Hanspal & V. Singh

106803 Improvements in or relating to method of cutting ceramic rods or tubes

106819 Ice shaving machine — T. D. Bansal, V. P. Wasan & S. S. Kalra

107057 A new method for manufacturing barium titanate material with improved characteristics — T. V. Ramamurti, C. V. Ganapathy, A. Ahmed, S. C. Gupta & T. R. Menon

**CFTRI**

105607 Detoxification process for groundnut cake or protein or any other foodstuff containing aflatoxin — V. Sreenivasamurthy, S. Srikanta & H. A. B. Parpia

107936 A process for the production of high calorie protein-rich pre-cooked ready-to-eat food products — M. Srinivasan, O. P. Kapur, K. S. K. Murthy, N. V. R. Iyenger, B. Anandaswamy & P. V. Raju

**CFRI**

103299 A process and apparatus for the production of fluxed formed briquettes of coals, chars, coke fines and iron concentrates — A. Lahiri, B. K. Mazumdar, A. K. Moitra, V. K. Das Gupta, S. Banerjee, B. Bose, J. M. Sanyal & R. Ghosh

104523 A process for the production of fluxed ash coke suitable for metallurgical processes — A. Lahiri, A. K. Moitra & N. G. Banerjee

[illegible] relating to the production of *ortho*-and *para*-xylene from coke oven or [illegible] conversion of three xylene

106321 A process relating to the production of *beta*-naphthaldehyde from *beta*-methylnaphthalene, a constituent of tar oils, obtained by both high and low temperature carbonization — S. K. Ray, Subodh K. Ray, G. S. Murty, H. S. Rao & A. Lahiri

107124 A process relating to the production of benzaldehyde from toluene, a constituent of coke oven benzole and petroleum naphtha — S. K. Ray, G. N. Kulsrestha, G. S. Murty, H. S. Rao & A. Lahiri

107860 A process relating to the production of benzoic acid from toluene, a constituent of coke oven benzole and petroleum naphtha — S. K. Ray, G. N. Kulsrestha, H. S. Rao & A. Lahiri

**CGCRI**

103959 Improvements in and relating to the manufacture of bonded abrasive wheels and shapes — B. Bhushan & S. Sen

107736 Improvements in or relating to insulation of ovens — S. M. Dasgupta

**NML**

105895 A process for the conversion of molten iron of various compositions to different grades of steel by employing air for oxidizing reactions — B. R. Nijhawan, A. B. Chatterjea & J. Mohan

106906 An improved method for removal of iron and upgrading ferrugenous chrome ores and other low grade ferrugenous ores — R. N. Misra, P. V. Viswanathan & P. P. Bhatnagar

107982 Stable castable suspension of non-plastic alumino-silicate materials and methods of making the same — A. V. Subrahmanyam & H. P. S. Murthy

108081 Refractory ramming, plastering and patching mixes consisting of kyanite and methods of making and using the same — M. C. Kundra & H. P. S. Murthy

108583 Chemically bonded forsterite refractories and methods of their preparation — M. C. Kundra & H. P. S. Murthy

**CDRI**

103973 A process for the preparation of 4-phenylisoflavan-4-ols and 4-4-phenylisoflav-3-enes of biological interest — R. Goalehari, R. N. Iyer, V. P. Khamboj & A. B. Kar

104319 N-Substituted 1-benzazepinos — J. M. Khanna & Nitya Anand

104388 New Central Nervous System depressants — A. P. Bhaduri, J. N. Sarma, C. Ram Prasad & N. M. Khanna

105190 A process for the recovery of anhydrous lanolin of B. P. and U. S. P. quality from crude wool fat — N. K. Garg & C. R. K. Murti

107244 A process for the preparation of isothiocyanates of biological interest — R. N. Iyer, R. Saxena & J. C. Katiyar

107626 A process for the preparation of homatropine and its hydrobromide — A. Samson, D. S. Bhakuani & R. P. Rastogi

107726 Substituted 1,2-diphenylnaphtho-(2,1-6) furans and intermediates therefor — H. P. S. Chawla, P. K. Grover, N. Anand, V. P. Ramboj & A. B. Kar

108145 A device for intra-ovarian injection in large animals — S. N. Chatterjee, S. K. Ahmed & A. B. Kar

**CRRI**

**CECRI**

103970 Improvements in or relating to direct plating of copper on aluminium — B. A. Shenoi, R. Subramanian & S. Seetharaman

103971 Improvements in or relating to etching of tantalum for use in electrolytic capacitors — B. A. Shenoi, K. R. Narasimhan & V. Lakshminarasimhan

103972 Improvements in or relating to the fabrication of negative electrode in silver oxide-zinc cells — P. B. Mathur & N. Karuppannan

104522 Improvements in or relating to the inhibition of self-corrosion of aluminium as a galvanic anode in alkaline media — N. Subramanyan & V. S. Kapali

105081 Chemical recovery of tin metal from the acid detinning bath — P. B. Mathur, R. L. Seth & N. Venkatakrishnan

105731 Improvements in or relating to the deposition of lead dioxide for use as electrodes — S. Sampath, R. T. Nadar & S. Nachiappan

106114 Improvements in or relating to rust and scale removing jelly — K. S. Rajagopalan & C. Rajagopal

106324 Improvements in or relating to primary wet cells — P. L. Joseph, V. Balasubramanian, G. Jothinathan, B. A. Shenoi & M. A. V. Devanathan

106325 Improvements in or relating to the fabrication of silver chloride activated batteries — P. B. Mathur & R. Balasubramanian

106806 Improvements in or relating to anode material and electrolyte in primary wet cell of the Leclanche type — N. Subramanyan, M. G. Potdar & V. S. Kapali

106807 A new manganese dioxide mix for oxygen depolarized cathodes — M. A. V. Devanathan, V. Aravamuthan, N. Ramaswamy & S. Venkatesan

106820 Improvements in or relating to the fabrication of cuprous chloride cells — P. B. Mathur, R. L. Seth, K. Dakshinamurthi, P. N. N. Namboodiri & N. Venkatakrishnan

107347 Improvements in or relating to the preparation of porous carbon electrodes from active carbons for use in air depolarized cells — A. K. A. Waheed, C. Chakravarthy, M. A. V. Devanathan & K. S. G. Doss

107414 Improvement in or relating to inhibition of corrosion during removal of rust and scale by acid solutions — K.S. Rajagopalan, N. Subramanyan & M. Sundaram

107437 Improvements in or relating to removal of rust and mill scale from mild steel surface — K. Balakrishnan, B. Satyanandam, N. V. Parthasaradhy & K. S. G. Doss

107624 Improvements in or relating to anodic phosphating — K. S. Rajagopalan, C. Rajagopal & B. Dandapani

107625 Improvement in or relating to prevention of tarnishing of copper and copper based alloys — K. S. Rajagopalan & R. Aravamudhan

107861 Improvements in or relating to lightning arrester/surge diverters — M. A. V. Devanathan, V. Rengachari, R. Radhakrishnan, K. S. G. Doss & J. P. Nityanandam

108573 Improvements in or relating to the electrochemical preparation of *para*-aminobenzoic acid — H. V. K. Udupa, M. S. Venkatachalapathy, A. P. Shakunthala & R. Kanakam

**CLRI**

107829 Modification of myrobalan tanning for its use as a self tanning agent — D. S. Mukherjee & Y. Nayudamma

**CBRI**

106805 A sand sampler — V. S. Aggarwal & S. S. Wadhwa

107058 An improved load cell — K. G. R. S. Jain & D. D. Shadev

107725 A tamping machine — J. P. Kaushish & S. A. Siddiqui

**CEERI**

104209 Improvements in or relating to condenser microphones

106964 Improvements in couplers for beam plasma amplifiers — Amarjit Singh, K. C. Gupta & H. S. Dewan

107724 A device for exact tracking particularly suited for sensitivity improvement of medium wave receivers — H. Singh & S. M. Sharma

**CSMCRI**

105060 A photoelectric instrument (circuit) for the measurement of whiteness — V. H. Vaidya & R. K. Sapre

108270 Recovery of anhydrous sodium sulphate by flotation process — M. V. Chanderikar, D. J. Mehta & D. S. Datar

108343 Process for the preparation of potassium carbonate using ion exchange technique — D. R. Baxi

**CMRS**

104389 Modified expansion shell type roof bolt — B. Singh & B. P. Verma

104524 Remote indicating hydraulic load cell — R. N. Gupta & B. Singh

104525 Lever-roller extensometer — P. R. Shenoy & B. Singh

104526 Remote indicating convergence indicator — R. N. Gupta & B. Singh

104527 Remote indicating hydraulic load cell using electrical resistance strain gauges — R. N. Gupta & B. Singh

104864 Vernier type convergence indicator — P. Pandey & B. Singh

106322 Clamp type friction prop with one hinge — B. Singh & N. C. Saxena

106323 Clamp type friction prop with hinges — B. Singh & N. C. Saxena

107830 Improved wedge and split type roof bolt — B. Singh & B. P. Verma

**RRL Hyd.**

104196 Process for the production of tristerin like materials from castor oil — G. L. Reddy & J. S. Aggarwal

105080 Odd-chain tertiary amine-N-oxides as surfactants and bactericides — B. H. N. Babu, P. K. P. S. Amma, S. V. Rao & K. T. Achaya

105120 A process for the preparation of N-alkyl-aminoalkyl benzamines — Y. S. Sadanandam, P. B. Sattur, G. S. Sidhu & S. H. Zaheer

105271 Process for retaining unsaturation during conversion of partially epoxidized glycerides and esters to corresponding mono-hydroxy compounds — K. T. Achaya & R. Subbarao

105732 Improvements in the process for the preparation of desiccant from gypsum — M. A. Hai, E. R. Saxena & G. S. Sidhu

**RRL Jorhat**

105930 A new material for manufacture of roofing sheets, building boards, pipes and sanitary fittings — K. L. Arora, Y. C. Kohkale & M. S. Iyengar

106219 Reclamation of old newspapers by deinking for the production of newsprint — B. P. Chaliha, S. B. Lodh & M. S. Iyengar

106776 A new type of fermentation unit — M. S. Kothari

**RRL Jammu**

105606 An improved process for the manufacture of salicylanilide — R. S. Thakur, P. R. Rao & K. Ganapathi

**CPHERI**

107912 Refrigerated vessels for maintaining biological tissues and cultures for minimum of 24 and maximum up to 48 hours period for continental, and intercontinental despatches — M. V. Bopardikar & V. R. Bhave

108437 A process for the manufacture of activated carbon for removal of fluorine from water — T. S. Bhakuni & C. A. Sastry

**CMERI**

104208 Electronic cyclic timer — P. K. Basu

105517 An instrument for measuring small displacement — L. Bhaduri

105997 Positive restriction indicator — B. K. Raju & G. V. Ramanaiah

105998 Restriction indicator — B. K. Raju & G. V. Ramanaiah

106205 Electronic (solid-state) load controller — P. R. Basu

107270 Indigenous fluorescent dye-penetrants for surface & sub-surface crack detection — S. G. N. Swamy

107438 Improvements in or relating to the cooling systems of internal combustion engines — G. V. Ramanaiah

108208 Combined break-back cum-lifting arrangement for reciprocating type agricultural mowers & implements — Chandra Mohan & B. S. Devgun

**MERDO Poona**

107983 Crack detector solution for non-ferrous metals & alloys — M. C. Narasimhan

**IIP**

105059 A device to improve the illumination obtained when burning low smoke point kerosenes in cylindrical wick type chimneyless lamps — K. S. Kambo & A. V. Venkatesh

106172 A process for the disproportionation of alkyl benzenes — G. S. Bhargava, P. Duhaut, G. Follain, M. Lal & N. Ray

106419 A process for the production of hydrous or anhydrous lanolin (superfine grade or better) from wool grease — S. K. Ghosh & B. S. Rawat

**SERC**

108209 Gripbars for concrete reinforcement — Z. George & G. S. Ramaswamy

**SRIFIR**

107439 Improvements in the production of thermosetting resins particularly suitable for surface coating — M. Krishnan, M. Venugopalan, Y. N. Sharma & R. T. Thampy

107440 Improvements in or relating to the production of thermosetting resins particularly suitable for moulding and lamination — M. V. Venugopalan, M. Krishnan & R. T. Thampy

108574 A process for the manufacture of water insoluble methylol derivatives of fatty alkyl mono carbomates and their application in textile treatment — V. B. Chipalkatti, N. B. Sattur & P. Bajaj

*Sponsored Research*

106514 Folding packing case — K. G. Philip

106513 Internal water flowing boat/ship — K. G. Philip

## Applications Accepted

**NCL**

96663 A new process for the manufacture of glycolic acid — H. G. Vartak & S. G. Patil

98155 An improved method for the hydration of sulphonated mixtures of vinyl copolymer beads containing 90-95 per cent sulphuric acid and the sulphonated vinyl copolymer beads — S. L. Kapur & K. Ramakrishnan

98156 Preparation of solvent modified copolymers of vinyl monomers in bead form — S. L. Kapur & K. Ramakrishnan

96801 A new method for the improvement in the figure of merit of thermoelectric materials — K. S. Vangipuram, L. Narasimhan & K. P. Sinha

97190 Improvements in or relating to extractors for extraction or similar processes — C. M. Shah & G. Narsimhan

101161 Process for the preparation of day-light and pink-light emitting electro-luminiscent phosphors — D. S. Ambardekar & A. B. Biswas

**NPL**

94271 An automatic leads cutting machine — S. Saran & Achhar Singh

95183 A device for the heat treatment of articles — M. K. Balchandani, V. P. Wasan & T. D. Bansal

96342 Improvements in ice point apparatus for maintaining a constant temperature of 0°C. —.V. P. Wasan & T. D. Bansal

98432 A process obtaining a machinable ceramic body — S. Saran, S. Rangarajan & T. V. Ramamurti

98590 Thermometer time lag testing machine — T. D. Bansal

98591 Improvements in thermometer cage — T. D. Bansal

**CFTRI**

95026 An improved process for the manufacture of lindane from technical benzene hexachloride (hexachlorocyclohexane) and utilization of the waste products — S. K. Majumdar & J. K. Krishna Rao

**CFRI**

99654 A process for the production of hard formed briquette cokes for domestic chemical

99655 A process for the production of hard briquette cokes and moulded shapes for non-coking coals, coke breeze and other similar carbonaceous materials suitable for domestic and/or metallurgical purposes — A. Lahiri, A. K. Moitra, S. Banerjee, B. Bose & J. M. Sanyal

**NML**

91134 Improvements in or relating to a precision temperature controller for use with electrical resistance furnaces up to 1600°C — K. P. S. Kumar & A. P. Chowdhury

94769 An improved device for the continuous hot-dip coating of metallic strip and wire — M. J. Shahani

94767 An improved cast iron pot for the melting and holding of non-ferrous molten metal in general, and aluminium & zinc in particular — M. J. Shahani

94768 An improved device for the isolation of dross in molten metallic baths during continuous hot-dip processing of strip or wire — M. J. Shahani

96661 A novel method of separating iron from ilmenite — S. Samanta, V. Sampath & P. P. Bhatnagar

96017 Production of high purity iron powder — S. S. Dhanjal, P. K. Gupte & B. R. Nijhawan

**CRRI**

95305 Improvements in or relating to pitch mastic compositions for road surfacing, concrete joint sealing, flooring, roofing, coating or like purposes — S. C. G. Swaminathan, B. C. Mazumdar & B. S. Mongia

96710 A process for the treatment of styrene pitch to obtain a viscous residue and a pungent smelling liquid distillate — B. C. Mazumdar

**CECRI**

88851 A process for the production of benzyl alcohol — H. V. K. Udupa, G. S. Subramanian, K. Natarajan & K. S. Udupa

93681 Production of black coatings on copper or copper-rich alloys — R. L. Seth, P. N. N. Namboodiri & P. B. Mathur

95074 A new depolarizer mix for use in alkaline primary cells — M. A. V. Devanathan, N. Ramasamy & S. Venkatesan

95306 Improvements in or relating to soldering of aluminium cables — B. A. Shenoi, R. Subramanian & G. S. Azariah

95423 Improvements in or relating to etching of tantalum — B. A. Shenoi, K. R. Narasimhan & K. L. Ramachandran

95425 Improvements in or relating to the electrochemical regeneration of chromic acid from chromium sulphate and sulphuric acid and use of the same for the oxidation of organic compounds and of *p*-nitrotoluene in particular to *p*-nitrobenzoic acid — H. V. K. Udupa, M. S. Venkatachalapathy & S. Chidambaram

96341 Improvements in or relating to the production of electrolytic manganese dioxide suitable as depolarizer for primary batteries — V. Aravamuthan & S. Visvanathan

96662 Improvements in or relating to etching and decorative anodizing of aluminium and its alloys — B. A. Shenoi & K. S. Indira

95419 Improvements in or relating to the sharpening of razor blades — M. A. V.

95421 Improvements in or relating to bright nickel plating — B. A. Shenoi & R. Subramanian

95420 Improvements in or relating to soldering of aluminium cables — B. A. Shenoi, R. Subramanian & S. Chakrapani

96690 Improvements in or relating to direct plating of copper on aluminium and aluminium alloys — B. A. Shenoi, R. Subramanian, C. Balasingh & C. Lakshminarayanan

96691 Improvements in or relating to electrodeposition of chromium-molybdenum alloys — B. A. Shenoi & K. S. Indira

95417 Improvements in or relating to an anode material for use in primary cells — M. A. V. Devanathan, N. Ramasamy & S. Venkatesan

97001 Improvements in or relating to the electrolytic reduction of *o*-nitrophenol to *o*-aminophenol — H. V. K. Udupa, G. S. Subramanian & P. N. Anantharaman

97004 Improvements in or relating to the soldering of magnesium and a soldering flux for magnesium — T. S. Srinivasan & P. B. Mathur

97005 Improvements in or relating to the electrodeposition of black chromium plating — B. A. Shenoi, K. S. Indira & S. Gowri

97003 Improvements in or relating to the electrolytic production of high quality fine grade silver powder — P. B. Mathur & N. Karuppannan

97002 Improvements in or relating to the electrolytic reduction of nitrobenzene to *p*-phenitidine — H. V. K. Udupa, G. S. Subramanian & P. Subbiah

96606 Improvements in or relating to preparation of lithographic aluminium plates — B. A. Shenoi, R. Subramanian & S. Chakrapani

96133 Anodic phosphating — K. S. Rajagopalan & B. Dandapani

96709 Improvements in or relating to the production of misch metal — V. Aravamuthan, K. Venugopalan & T. P. Madhavan

96605 Improvements in or relating to spray drying techniques with special application to electrolytic recovery of magnesium, misch metal and the like — Gopalan Janakiraman, P. S. Desikan & V. Aravamuthan

98148 Improvements in or relating to a device for the sharpening of razor blades — M. A. V. Devanathan, V. K. Venkatesan & S. Sarangapani

98157 Improvements in or relating to a matrix electrode for use in alkaline cells — M. A. V. Devanathan, N. Ramaswamy & S. Venkatesan

98158 Improvements in or relating to alkaline manganese dioxide wet cells — M. A. V. Devanathan, N. Ramaswamy & S. Venkatesan

98159 Improvements in or relating to the preparation of lead acid battery plates — H. V. K. Udupa, S. Sampath, R. Chandran, S. Palanichamy & C. J. Johny

98206 A process for the corrosion inhibition of aluminium working as electrodes — M.A. V. Devanathan, B. A. Shenoi, P. L. Joseph & V. Balasubramanian

99181 Improvements in or relating to the electrolyte reduction of nitroguanidine to aminoguanidine — H. V. K. Udupa, G. S. Subramanian & K. S. Udupa

100313 Improvements in or relating to etching of foils of aluminium or aluminium alloys for capacitors — B. A. Shenoi, K. R. Narasimhan, V. Srinivasan & A. Anantharaman

101628 Detinning of tin scraps in inhibitor impregnated acid medium — N. Venkatakrishnan, R. L. Seth & P. B. Mathur

**CLRI**

97245 Improvements in or relating to toggles for straining leather for drying, Type B — K. S. Rao

97191 One lung twin glazer — T. Ramanathan

**CBRI**

93575 Improvements in or relating to the manufacture of tiles from plastic clays — S. L. C. Jain, R. B. Hajela & N. K. Srivastava

95182 A torque limiting spanner — P. V. Pawar & N. V. Raman

98142 An instrument designated as "archo solslider" for making calculations of shadow coverages and values of direct solar radiations on surfaces — K. L. Datta & B. B. Garg

**CEERI**

97444 An improved vacuum whirler for applying thin and uniform coating of an emulsion on a wafer — K. S. Balain & Inderjeet Singh

**CMRS**

97123 A safety device for cages of lifts in case of winding rope breakage — B. Singh & R. K. Prasad

98143 A device for the measurement of displacement between two points — Bhagwant Singh

98144 Suspension type convergence indicator —Bhagwant Singh

98145 Improved type convergence recorder — Bhagwant Singh & K. N. Sinha

98154 A load cell — B. Singh & R. K. Prasad

**RRL Hyd.**

93481 A process for the production of motor fuels and middle distillates such as motor spirit diesel oils and kerosene-substitutes from primary tar fractions — (Mrs) A. Mirza, M. A. Masood, A. V. Ramaswamy, S. A. Quader & R. Vaidyeswaran

94932 A process for the production of diesel oils & illuminants from primary coal tar and petroleum fractions — S. A. Quader, (Mrs) A. Mirza, M. A. Masood & R. Vaidyeswaran

96420 Improvements in or relating to the manufacture of benzaldehyde from benzal chloride or from chlorinated toluene mixture of high benzal chloride content — I. K. Tacker, H. Dakshinamurthy, G. S. Sidhu & C. R. Mani

96421 Improvements in or relating to the manufacture of benzol chloride by the reaction of benzotrichloride and benzoic acid — I. K. Tacker, G. S. Sidhu, A. Dakshinamurthy & S. I. Ahmed

96422 Improvements in or relating to the manufacture of benzoic acid from benzotrichloride — I. K. Tacker, G. S. Sidhu, H. Dakshinamurthy & S. I. Ahmed

101926 Improvements in or relating to the manufacture of benzoyl chloride from benzotrichloride — I. K. Kacker, H. Dakshinamurty, G. S. Sidhu & S. I. Ahmed

**CMERI**

98152 Dye-penetrants containing indigenous materials for surface and surface cracks detection — S. G. N. Swamy

98151 Improved latch arrangement — S. N. Bhagi

94863 Improvements in or relating to processing of textiles for imparting simultaneously improved tear resistance & abrasion resistance — V. B. Chipalkati, R. M. Desai, N. B. Sattur & I. Hussain

95424 Improvements in or relating to the thermosetting resinous composition — S. P. R. Nair, M. Krishnan & R. T. Thampy

97000 A process for treating cellulosic textile material to impart simultaneously high dry crease recovery, high wet crease recovery and high abrasion/tear resistance — V. B. Chipalkatti, R. M. Desai, N. B. Sattur & I. Hussain

99657 Improvements in or relating to the manufacture of sodium carboxy alkyl starch — H. R. Chipalkatti & A. S. Jaffal

*Sponsored Research*

93764 A process for the manufacture of portland cement without gypsum — D. K. Nath & D. Lahiri

98149 An instrument for the measurement of soil moisture — M. Salaruddin & B. V. Khasbardar

**Banaras Hindu University, Varanasi**

98141 Some new vapour phase inhibitors of corrosion for mild steel, copper, brass and aluninium — V. S. Agarwala & K. C. Tripathi

**H. B. Technology Institute, Kanpur**

98150 A process for synthetic fibre from neem cake — B. D. Agarwal & Bhola Nath

## Applications Sealed

**NCL**

90677 A new method for the preparation of formic acid — H. G. Vartak, S. G. Patil & S. V.Paranjpe

92977 Improvements in or relating to the manufacture of hexachloroethane — S. P. Mukherjee, M. G. S. Soundararajan, M. Goswamy, N. Sadasivan, R. K. Sen & L. K.Doraiswamy

**NPL**

92277 Improvements in or relating to process of production of ceramic rods for pyrolytic carbon resistors — S. Sharan & S. Rangarajan

93725 Improvements in or relating to hard ferrites — T. V. Ramamurti, C. V. I. Ganapathy, R. Krishnan, A. Ahmed, S. C. Gupta & G. I. Govindaswamy

**CGCRI**

91430 Improvements in or relating to manufacture of reconstituted mica — Atma Ram & S. B. Ry

**CRRI**

90470 Improvements in or relating to the manufacture of lime-surkhi mixture — N. R. Srinivasan, M. L. Bhatia, R. K. Ghosh & S. R. Mehra

93726 Improvements in or relating to the manufacture of reactive surkhi — N. R. Srinivasan, M. L. Bhatia, R. K. Ghosh & S. R. Mehra

**CECRI**

91828 Improvement in or relating to the preparation of sintered silver plates for batteries — P. B. Mathur & N. Karuppannan

95423 Improvements in or relating to etching of tantalum — B. A. Shenoi, R. K. Narasimhan & K. L. Ramachandran

**CBRI**

91411 A new soil sampler — A. K. Deb & V. S. Aggarwal

**NBG**

92976 Improvements in or relating to the isolation of trilauric or lauric acid from the fruits of *Cinnamomium cecidodaphne* Meissn — A. Singh, S. N. Srivastava, V. N. Sharma & K. N. Kaul

**CMRS**

90238 A microscope eyepiece graticule for rapid determination of projected specific surface of particulate material — S. Guruswamy

**RRL Hyd.**

90676 A process for the extraction and recovery of phenols from distillates of coal tar & Mineral oil distillates containing phenols — S. M. Ahned, Y. N. S. Rao, R. Vaidyeswaran & G. S. Sidhu

**SRIFIR**

90675 Improvements in or relating to the manufacture of phosgene (carbonyl chloride) R. T. Thampy & S. R. Goel

92757 Improvements in or relating to the treatment of cellulosc materials to render them rotproof and/or waterproof — R. M. Desai, A. K. Jan & S. M. Dhanigond

94863 Improvements in or relating to the processing of textiles for imparting simultaneously improved tear resistance & abrasion resistance — V. B. Chipalkatti, R. M. Desai, N. B. Sattur & I. Hussain

## FOREIGN COUNTRIES

### Applications Filed

**CFTRI**

Brazil No. 184908
Indian No. 105607 Detoxification process for groundnut cake r protein or any other foodstuff containing aflatoxin — V. Sreenrasamurthy, S. Srikanta & H. A. B. Parpia

**CFRI**

French No. 75407
Indian No. 100675 An integrated process (OLEO flotation) or upgrading and dewatering of small coal — A. K. Chakravrti, J. Chattopadhyay, G. G. Sarkar & A. Lahiri

USA No. 594358
Indian No. 100675 An integrated process (OLEO flotation) for upgrading and dewatering of small coal — A. K. Chakravarti, J. Chattopadhyay, G. G. Sarkar & A. Lahiri

**CECRI**

UK No. 05683
Indian No. 96133 Anodic phosphating — K. S. Rajagopalan & B. Dandapani

**CLRI**

USSR No. 1088976
Indian No. 90469 Method for processing of raw mammalian intestines into dry ready-to-wet intestines suitable for use as surgical suture, sausage casings, sports guts or the like — S. K. Barat

### Applications Accepted

**NCL**

UK No. 1051660
Indian No. 86991 Preparation of polyurethane printing rollers — N. D. Ghatge & S. L. Kapur

**CLRI**

Norway No. 153612
Indian No. 90469 Process of dry ready-to-wet sausage casings from cattle, goat, sheep, pig and other mammalian intestines — S. K. Barat

**CEERI**

UK No. 1043599
Indian No. 86639 An inexpensive chemical method of dicing a semiconductor slice for the manufacture of transistor family devices — K. S. Balain

**RRL Hyd.**

UK No. 102638
Indian No. 87992 Direct preparation of waxesters by fatty acids hydrogenolysis — A. J. Pantulu, K. T. Achaya, G. S. Sidhu & S. H. Zaheer

### Applications Sealed

**NCL**

German No. 1196633
Indian No. 58868 A process for the preparation of azelaic acid semiester suitable for making civetone dicarboxylic acid—U. G. Nayak, K. K. Chakravarti & S. C. Bhattacharyya

**CLRI**

New Zealand No. 138370
Indian No. 90469 Processing of dry ready-to-wet sausage casings from cattle, goat, sheep, pig and other mammalian intestines — S. K. Barat

**CEERI**

Italy No. 702939
Indian No. 86639 An inexpensive chemical method of dicing a semiconductor slice for the manufacture of transistor family devices — K. S. Balain

**RRL Hyd.**

## Appendix 11

## PROCESSES RELEASED FOR COMMERCIAL DEVELOPMENT TO INDUSTRY

| *Process* | *Party* | *Conditions* |
|---|---|---|
| **NCL** | | |
| Preparation of rubber corksheet | Bharat Casement Pvt. Ltd, Calcutta | Technical aid |
| Preparation of insoluble reaction products of polystyrene for use as cation exchange materials (I. P. No. 74356) | Tulsi Industries, Poona | Non-exclusive |
| Extraction and utilization of sisal wax (I. P. Nos. 65440 & 64958) | Shalimar Rope Works Ltd, Calcutta | Non-exclusive |
| Water dispersible DDT as an oil bound paste ( I. P. No. 56726) | Lotus Industries, Madras | Non-exclusive |
| Nicotine sulphate from tobacco and tobacco waste (I. P. Nos. 45666, 54867, 46994 & 83718) | Shri M. M. Pate, Sunav | Non-exclusive for Maharashtra and Gujarat zones |
| Polyurethane base printing rollers (I. P. No. 86991) | United Ink & Varnish Co., Bombay | Non-exclusive |
| **NPL** | | |
| Piezoelectric material (I. P. No. 103201) | Piezoelectric Ceramics India, New Delhi | Non-exclusive |
| Soft ferrites (I. P. No. 87993 & 101626) | UMS Radio Factory, Coimbatore | Non-exclusive |
| Ceramic rods for carbon resistors (I. P. No. 92277) | Mahaliram Lachman Dass Chemical Porcelain Factory, Khurja (U.P.) | Non-exclusive |
| Hard ferrites (I. P. No. 93725) | W. S. Insulators of India Ltd, Madras | Non-exclusive |
| | Molecular Electronics Pvt. Ltd, Calcutta | |
| | Matchwel Electricals Pvt. Ltd, Poona | |
| Traffic control device | Control & Switchgear Co., New Delhi | Non-exclusive |
| **CFTRI** | | |
| Integrated process for groundnut protein isolate | Tata Oil Mills Co. Ltd, Bombay | Exclusive |
| Processing of silkwork pupae for poultry feed | Janab Jabbar Sherif Secriculturist, Ramanagaram, Mysore State | Free of charge |
| Mustard powder | Kissan Products Pvt. Ltd, Bangalore | Technical aid (Exclusive) |
| Tonic wine | F. K. Research Products, Mysore | Exclusive |
| **CGCRI** | | |
| Grinding wheel for safety razor blades (I. P. 103959) | Harbans Lal Malhotra Pvt. Ltd, Calcutta | Non-exclusive |
| Wetground mica | Shri Jaswant Raj Mehta, New Delhi | Exclusive for 10 years and Non-exclusive for 4 years |
| Boron free enamel | Sur Enamel & Stamping Works Pvt. Ltd, Calcutta | Non-exclusive |
| Glass and calomel electrodes for *p*H meter | Karampura Development Corporation Ltd, Calcutta | Non-exclusive |
| **NML** | | |
| Improvement in or relating to modification of aluminium alloys containing silicon (I. P. No. 76415) | Prof. Dr Ing. A. Witmosar Professor of Metallurgy, University of Amehan, West Germany | Exclusive Germany and other European countries |
| Recovery of metallics from zinc dross | Indian Tube Co., Jamshedpur | Technical aid |
| Recovery of aluminium from aluminium dross | Shri V. K. Paranjpe, Jamshedpur | Technical aid |
| Carbon free ferro alloys (I. P. No. 65231) | Jeypore Sugar Co. Ltd, Madras | Non-exclusive |
| Production of graphite crucibles (clay bonded) (I.P. No. 62352) | J. D. Jones Co. Ltd, Calcutta | Non-exclusive |
| Ceramic magnets | G.P. Tolani & Co., Bombay | Non-exclusive |
| Hot dip aluminizing of ferrous materials (I. P. Nos. 55289, 57938 & 65230) | Asian Industries, Meerut | Non-exclusive |
| | D. S. Chawbey & Son Pvt. Ltd, Calcutta | |
| | Rajasthan Steel Wire Products, Jaipur | |
| | Paramount Iron & Steel Works Pvt. Ltd, Sonepat | |
| | Dokania Galvanizing Works, Giridih | |
| | Technology Syndicate, Ranchi | |
| | The Navasari Processing Industry Pvt. Ltd, Navasari | |
| | The General Manager, P & T Workshops, Calcutta | |
| | Bonita India Ltd, New Delhi | |
| | Shankar Industries Ltd, Calcutta | |
| | Hindustan Construction & Commercial Corporation, Calcutta | |
| | Gupta Aluminizing Industries, Kanpur | |

| Process | Party | Conditions |
|---|---|---|
| Electrical resistance alloys for heating element | Cable Works (I) Ltd, Calcutta | Non-exclusive |
| Thermostatic bimetal | Cable Works (I) Ltd, Calcutta | Non-exclusive |
| **CDRI** | | |
| Manufacture of dapsone | Anglo-French Drug Co., Eastern Ltd, Bombay | Feasibility report against payment |
| Manufacture of paracetamol | do | do |
| Manufacture of psoralen | do | do |
| Preparation of peptone & meat extract from meat | Biochemical & Synthetic Products Ltd, Hyderabad | Free of charge |
| Process for the production of Thiacetazone | Gujarat Pharmaceutical & Chemical Works, Ahmedabad | Project Report |
| **CRRI** | | |
| Lime reactive Surkhi mixture (I.P. No. 90470) | Bombay Machinery Co., Delhi | Non-exclusive |
| Reactive Surkhi (I. P. No. 93726) | Bombay Machinery Co., Delhi | Non-exclusive |
| | Amar Nath Bhaskar and Sons, New Delhi | |
| **CECRI** | | |
| Vapour phase inhibited anticorrosive paper (I. P. No. 101924) | Kotes (I) Ltd, Bombay | Non-exclusive |
| | Rolls Print, Calcutta | do |
| Benzidine (I. P. No. 68869) | Kabbur Dyes Pvt. Ltd, Bombay | Non-exclusive |
| Misch metal | Vishwanath Saraf, Calcutta | Exclusive |
| Aluminium lithoplate | Reprografix Ltd, Sivakasi, Madras State | Non-exclusive |
| Calcium gluconate (I. P. No. 51189) | Gujarat Pharmaceutical & Chemical Works, Ahmedabad | Non-exclusive |
| Preparation of *para*-aminophenol and 2 : 4-diaminophenol (I. P. Nos. 53195, 60865,71978 and 79212) | Gujarat Pharmaceutical Works, New Chamuna Mata Asaram, Ahmedabad | Non-exclusive |
| | Shetty Pharmaceuticals & Biologicals Ltd, Bombay | Non-exclusive |
| | Shri M. Srinarayan Anamalai, Madras State | Non-exclusive |
| **CLRI** | | |
| Enzyme depilants and bates (I. P. Nos. 52670, 54998 & 64354) | Coromandel Chemicals, Madras | Non-exclusive |
| Manufacture of latex cement (I. P. No 66298) | Coromandel Chemicals, Madras | Non-exclusive |
| Manufacture of syntans | Indofil Chemicals Ltd, Bombay | Non-exclusive |

| Process | Party | Conditions |
|---|---|---|
| Improved method of bag tanned sole leather, suitcase, leather vegetable tanned sheep and goat skin and glossy finish | RIP Centre, Nawadah, Bihar | Free of charge |
| Manufacture of Katai leather | Unique Tannery Co. Ltd, Calcutta | Free of charge |
| Manufacture of chrome and chrome retain shoe upper leather | Universal Leather Industries, Calcutta | Free of charge |
| Manufacture of white leather from goat and sheep skins for Katai chappals | Barang Muchi Cooperative Society, Baranj | Free of charge |
| Improved bag tanned leather from cow hide | Barang Muchi Cooperative Society, Baranj | Free of charge |
| Manufacture of full chrome upper leather and chrome retain leather for shoe upper and leather goods | Universal Leather Industry, Calcutta | Free of charge |
| | South East Tanneries (P) Ltd, Calcutta | Free of charge |
| Hide powder | Coromandel Chemicals, Madras | Exclusive |
| Acid washing scouring bleaching softening goat hair wool buffalo and camel hair | South East Tanning Co, Madras | Non-exclusive |
| Manufacture of Rapid Tan lining leather from wet salted cow hides | South East Tanneries (P) Ltd, Calcutta | Free of charge |
| Manufacture of improved quality Zug-grain leather from wet salted cow hides | do | do |
| Manufacture of wet blue goat skins for export | East India Chrome Tannery (P) Ltd, Calcutta | do |
| Process for sole leather manufacture | Abdul Wahid, Nasirabad | do |
| Manufacture of white chrome lining leather from wet salted sheep skin | do | do |
| Process for fur dressing | do | do |
| **CBRI** | | |
| Water and weather-proof composition based on CNSL | Bonita Ltd, New Delhi | Exclusive |
| A new soil sampler (I.P. No. 91411) | M. S. J. (Engineer) Co., Roorkee | Exclusive |
| Pressure measuring device | Associated Instruments Mfg, New Delhi | Exclusive |
| Cement paints | Bonita India Ltd, New Delhi | Non-exclusive |
| | Hyderabad Oil & Paint Co., Hyderabad | Non-exclusive |
| Semi-mechanized process for brick making | Badri Prasad Poddar, Calcutta | Free of charge |
| | Bashir Ali & Bros, Lucknow | do |
| | Sri G. S. Venkataraman, Calicut | do |
| | Sri R. Goaswami, Calcutta | do |
| Water, weather proofing resin | Metal Life India Pvt. Ltd, | do |

| Process | Party | Conditions |
|---|---|---|
| Water, weather-proofing resin | Prasanna Industries, Poona | Free of charge |
| | Sri Jivan Lal Patel, Sambalpur, Orissa | do |
| | India Paint & Chemicals, Cuttack | do |
| Particle board from coconut husk | Coir Board, Ernakulam | do |
| D. C. tiles & cellular roofing systems | Maharashtra Housing Board, Bombay | do |
| Cores unit roofing system | Bombay Municipal Corporation, Bombay | do |
| Precast lintels | C.P.W.D., Madras Central Division | Free of charge |
| Ceramic Tile beam roofing system | Mahalaxmi Sugar Mills, Saharanpur | Free of charge |
| **CEERI** | | |
| Television receiver | Telerad (P) Ltd, Bombay | Non-exclusive |
| Moving coil microphone | Bhatty Mercantile, Bombay | Non-exclusive |
| | McKenzie Philips India Ltd, Delhi | Non-exclusive |
| **CSMCRI** | | |
| Plaster of paris bandage | 17 firms | Free of charge |
| Manufacture of hydrated calcium silicate from lime and silica sol | Anand Industrial Enterprise, Sonepat | Technical aid |
| Manufacture of magnesium chloride | Bharat Salt & Industrial Works, Bhavnagar | Technical aid |
| Washing of salt | Jayshree Chemicals Ltd, Ganjam | Technical aid |
| Sodium alginate from sea weeds | Cellulose Products of India, Ahmedabad | Free of charge |
| **CMRS** | | |
| Carbon monoxide detector tubes | Mine Safety Appliances Calcutta | Non-exclusive |
| **RRL Hyd.** | | |
| Barium potassium chromate | Dr R. J. Rathi, Sundarshan Chemical Industries (P) Ltd, Poona | Non-exclusive |
| Potassium permanganate | Essar Chemicals, Dhulia | Non-exclusive |
| Terpiniol & terpin hydrate from carnes | Camphor & Allied Products, Bareilly | Non-exclusive |
| Designing of stripping column | Satyadev Chemicals Pvt. Ltd, Baroda | Technical aid |
| Glass lining of M. S. vessels | Andhra Foundry & Machine Co. Ltd, Secunderabad | Non-exclusive |
| | | Non-exclusive |

| Process | Party | Conditions |
|---|---|---|
| Standard pyrometric cones | Micro Ceramics Ltd, Hyderabad | Exclusive |
| Manufacture of benzyl chloride (I. P. No. 71864) | Gujarat Chemical and Pharmaceuticals, Ahmedabad | Non-exclusive |
| Hydrazine sulphate (I. P. No. 71321) | Rechem Pvt. Ltd, Hyderabad | Turnkey job |
| **CMERI** | | |
| Loop paper insulating machine | Kumardhubi Engineering Works Ltd, Dhanbad | Exclusive |
| Electronic comparator | Westing House Saxby Farmer Pvt. Ltd, Calcutta | Exclusive |
| Design of a wind tunnel | Gasket & Oilseeds Ltd, Baroda | Technical aid |
| Flexible coupling | Neofabrico, Calcutta | |
| Electrodynamic balancing machine | Industrial Agricultural Engineering Co., Calcutta | Exclusive |
| Water cooler | Century Refrigeration, Calcutta | Exclusive |
| Pneumatic hammer | Bird & Co., Calcutta | Exclusive |
| Electronic timing | Techno India, Bombay | Exclusive |
| Development of an escalator | Dynacraft Machine Co. Ltd, Bombay | Exclusive |
| Dye penetrant for crack detection (I. P. No. 98152) | Pioneer Equipment Co. Pvt. Ltd, Calcutta | Exclusive |
| Shearing and punching machine | Appejay Structural Ltd, Calcutta | Exclusive |
| **CSIO** | | |
| Development and production of process camera prism | Monotype Corporation Ltd, New Delhi | Technical aid |
| Optical design for 14 in. internal focusing dumpy level objective | 10 parties | Technical aid |
| Optical design for internal focusing level objective | 7 parties | Technical aid |
| Optical design for episcope objective | 8 parties | Technical aid |
| Optical design for diascope objective | 7 parties | Technical aid |
| Optical design for film strip projector objective | 7 parties | Technical aid |
| Optical design for microscope objective | 9 parties | Technical aid |
| Optical design for box camera objective | Mr Holger Nielsen UNTAB Expert, SISI, Okhla, New Delhi | Technical aid |
| Visual colorimeter | Oriental Science Apparatus Workshops, Ambala Cantt | Technical aid |
| **IIP** | | |
| Reclamation of used lubricating oil | 9 parties | Report against payment |

## Appendix 12

## PROCESSES WHICH HAVE GONE INTO PRODUCTION

| *Process* | *Party* | *Conditions* |
|---|---|---|
| **NCL** | | |
| Porous rigid filters | J. N. Prashad Aggarwal, New Delhi | Exclusive |
| Polyurethane base printing rollers | Sree Saraswaty Press Ltd, Calcutta | Non-exclusive |
| | United Ink & Varnish Co., Bombay | Non-exclusive |
| Berberine hydrochloride | G. Vallabhdas & Co., Bombay | Technical aid |
| **NPL** | | |
| Soft ferrites | Morris Electronics Pvt. Ltd, Poona | Non-exclusive |
| | Semiconductors Ltd, Poona | Non-exclusive |
| Ceramic rods for carbon resistors | Microceramics Ltd, Hyderabad | Non-exclusive |
| **CFTRI** | | |
| Instant mixes (Idli, Vadai, Jamoon and Jilebi) | Gits Food Products, Poona | Technical aid |
| Liquid guava and banana | South India Research Institute, Vijayawada | Technical aid |
| **CGCRI** | | |
| Glass and calomel electrodes for *p*H meter | Electronic and Industrial Instrument Co. Pvt. Ltd, Hyderabad | Non-exclusive |
| **NML** | | |
| Carbon-free ferroalloys | R. Sen & Co., Calcutta | Non-exclusive |
| **CRRI** | | |
| Lime reactive surkhi | Amarnath Bhasker, New Delhi | Non-exclusive |
| **CECRI** | | |
| Porous carbon electrode for air depolarized cells | Carbon Industries Pvt. Ltd, Madras | Non-exclusive |
| Synthetic cryolite | Phosphate Co. Ltd, Calcutta | Technical aid |
| **CBRI** | | |
| Cement paint | Bhagson Paint Industries (India), New Delhi | Non-exclusive |
| **CEERI** | | |
| Four point resistivity probe | Oriental Science Apparatus Workshop, Ambala Cantt | Non-exclusive |
| **CSMCRI** | | |
| Agar agar from sea weeds | Cellulose Products of India, Ahmedabad | Technical aid |
| **RRL Hyd.** | | |
| Bleaching earths | Korvi Fullers Earth Processing Industries, Gulberga | Non-exclusive |
| Chloroform and chloral hydrate | Commercial Chemical Co., Hyderabad | Non-exclusive |
| Barium potassium chromate | Sudarshan Chemical Industries Pvt. Ltd, Poona | Non-exclusive |
| Aluminium zinc oxide primer | Indian Aluminium Co., Calcutta | Sponsored research |

## Appendix 13

## PUBLICATIONS

### Books and Monographs

Handbook on Landslide Analysis and Correction (CRRI), pp. 117

Phenomenon of power loss at altitudes: Some possible remedial measures for counteracting the problems (IIP)

Fuel prob'ems at high altitudes and Sub-zero temperatures (IIP)

Lubricant problems at high altitude and Sub-zero temperatures (IIP)

Self-sufficiency in systems for Aeronautics (NAL)

The Many Electron Problem (NAL), pp. vii+244

Handbook for ultimate strength design of R. C. members (SERC), pp. 169

The Wealth of India: Raw Materials, Vol. VII (N-Pe), (PID), pp. XXXVII+330

Indian Fossil Pteridophytes (Botanical Monograph No. 4) (PID), pp. iv+209

Illustrations to Flora of Delhi (PID), pp. xx+282

Monograph on Census in India 1961, Scientific and Technical Personnel (DSTP)

Indians Abroad Directory (Engineers) (Nos. 2) (DSTP)

Indians Abroad Directory (Medical Personnel) (DSTP)

Indians Abroad Directory (Scientists & Technologists) (DSTP) (Nos. 2), Pool Directories (Nos. 11) (DSTP)

Jalka Chamatkar (Hindi, Marathi, Malayalam, Urdu, Kannada, Gujerati), (ILU), pp. 32 in each case

Bijli ka Chamatkar (Hindi, Marathi, Malayalam, Urdu, Kannada), (ILU), pp. 40 in each case

Hawa ka Chamatkar (Hindi), (ILU), pp. 40

Chumbak ka Chamatkar (Hindi, Marathi, Malayalam, Urdu), (ILU), pp. 40 in each case

Bal Bhautiki (Hindi), (ILU), pp. 40

Sagar ki Kahani (Hindi), (ILU), pp. 48

Khal Upchar-Vidhiyan aur Vevsay (Hindi), (ILU), pp. 48

Directory of Hindi Scientific & Technical Publications, 1965 (Hindi), (ILU), pp. 214

### Proceedings of Symposia, Seminars and Conferences

Programme and abstracts of papers of Seventh Seminar on 'Electrochemistry' (CECRI), pp. 53

Forum on Brick and Tile Manufacturers (CBRI), pp. 23 (Cyclostyled)

Rural housing (CBRI), pp. 11 (Cyclostyled)

Multi-storeyed Housing for Low Income Group (CBRI), pp. 15 (Cyclostyled)

Fatty acids (RRL Hyd), pp. viii+89

CNS Drugs (RRL Hyd), pp. xv+367

Water Pollution Control, Vol. I: Sewage Treatment (CPHERI), pp. vii+146

All India Get-together of Cable & Wire Industry (CMERI), pp. 52

Key Paper on Ores & Minerals, Mining, Geophysics and Oceanography and Recommendations brought out after the Conference on Research & Industry held in New Delhi in December 1965 (NGRI)

Abstracts of papers presented in the Symposium on Coastal and Nearshore Oceanography (NIO)

Water evaporation Control (Insdoc)

Seminar on Work-flow in Libraries, 1966 (Insdoc), (mimeographed)

Thirty-third International Foundry Conference — Who's Who (Insdoc), pp. 51

First Get-Together of Research and Industry: Working Group 1 (Electronics, Instruments, Radio, Television, Public Address Systems, Standards, Physics based industries), (PID) pp. 65

Working Group 2 (Industrial Organic Chemicals, Biochemistry, Dyes, Intermediates, Rubber, Resin, Adhesives, Plastics, Paints, Varnishes, Surface Coatings), (PID), pp. 13

Working Group 3 (Inorganic and Heavy Chemicals, Fertilizers, Cements, Marine Chemicals) (PID), pp. 62

Working Group 4 (Drugs & Pharmaceuticals, Medicinal and Aromatic plants, Public Health Engineering), (PID), pp. 36

Working Group 5 (Chemical Plant and Equipment, Electrical & Mechanical Engineering, Agricultural, Textile and Mining Machinery, Automobiles), (PID), pp. 115

Working Group 10 (Petroleum Refining, Petrochemicals, Petroleum Technology and Oil & Gas Exploration), (PID), pp. 21

Working Group 11 (Energy, Coal), (PID) pp. 7

Working Group 12 (Glass, Ceramics, Enamels, Clays & Refractories, Mica), (PID), pp. 15

Working Group 13 (Aeronautical Engineering, Aircraft Structures, Materials, Propulsion Systems, Aviation Fuel), (PID), pp. 12

### Folders and Brochures

Optical Glass (CGCRI)

Mineral Beneficiation Pilot Plant (NML)

NML Brochure

Open Day (English and Hindi) (CBRI), pp. 11 (Cyclostyled)

Special Course on Building Physics (CBRI), pp. 106 (Cyclostyled)

Our activities in electronic instrumentation (CEERI), pp. 7 (Cyclostyled)

Some products developed at CEERI, (CEERI), pp. 24 (Cyclostyled)

Motive Power Gallery (BITM)

Transformation of Energy (BITM)

Saktir Rupantar (Bengali) (BITM)

Guide Book to the Museum (Bengali and Hindi) (BITM)

Oxidation Ponds (CPHERI), pp. ii+20

Activities of CPHERI, pp. 33

Service and Maintenance Centres (CSIO)

Self-reliance through Science and Technology (CSIO), pp. 8

Special training courses in petroleum refining and petrochemicals and utilization of petroleum products in engines and industry (IIP)

Training of Engineers and Scientists for Refining, Marketing Petrochemical and Product Application Industries (IIP)

Digital computational facilities at the computer centre (CERC), pp. 7

Reviews on Botanical Monographs (PID), pp. 46

Protection against Earthquake Damage (PID), pp. 10

Dissertations and Citations relating to S. S. Bhatnagar Memorial Awards (PID), ten nos.

Irrigation Channels (Hindi) (PID), pp. 10

Unesco, What it is, What it does, How it works (Hindi, Bengali, Marathi, Tamil and Malayalam) (ILU), pp. 16 in each case

National Physical Laboratory (Hindi) (ILU), pp. 40

**Reports**

NCL Annual Report 1965-66, pp. ix+127

CFTRI Annual Report 1964-65, pp. vi+180

Report of the Director, CFRI, for the year 1963-64

CFRI Summary Report for the year 1965

NML Annual Report 1965-66

CDRI Annual Report 1964-65

CRRI Annual Report 1965, pp. 79

CECRI Annual Report 1965, pp. 83

CBRI Annual Report 1965, pp. vii+67

RRL Hyd. Annual Report 1965-66, pp. xxi+122

CPHERI Annual Report 1965-66 (Cyclostyled)

IIP Annual Report 1963-64

NAL Annual Report 1965-66

NGRI Annual Report 1966, pp. 43

SERC Annual Report 1965-66, pp. 33

CSIR Annual Report, 1965-66 (PID), pp. ix+191

RSPO Annual Report 1965-66 (PID), pp. 23

CRIR Annual Report 1965 (Hindi) (ILU), pp. 215

**Bibliography**

School Building (CBRI)

Catalogue of Serials in the Indian Institute of Science Library, Bangalore (Insdoc), pp. 395

Catalogue of Serials in the Indian Statistical Institute, Calcutta (Insdoc), pp. 383

33rd International Foundry Conference, Technical books exhibition, Catalogue of exhibits (Insdoc), pp. 54

Agro-Chemicals (preliminary list of recent references on Indian Work) (Insdoc), pp. 39 (mimeographed)

Metropolitan Areas in Asia, 1961-66 (Insdoc), pp. 43 (mimeographed)

Standards on Foundry Practice (Insdoc), pp. 33

Work-flow in Libraries (Insdoc), pp. 29

**Research Reports/Project Reports/Mimeographed and Cyclostyled Reports**

**CFRI**

Report of Investigation on Coal Cores from special bore holes drilled in Pundi Block West Bokaro Coalfield

Shorport Ret on the Batch Carbonization Test with Katkona Coal from M. P. in the prototype LTC plant at CFRI

A report of Investigations on the carbonization potentialities of Umrer coal in the prototype LTC plant at CFRI

Report on full-scale medium temperature carbonization Test on Singarauli Coal (M.P.) in the prototype LTC Plant at CFRI

Second Report on investigation on the carbonization potentialities of coal from Churcha Colliery (M.P.) Jhilimili Coalfield in coking Blends

Feasibility Report of Sudamdih coal Washery Project (Part I)

A Reassessment of the Talcher Project

Report of Operating Conditions of Durgapur coke ovens of Durgapur Projects Ltd

Investigations on the Medium to Low Temperature Carbonization Potentialities of coals from Churcha-Katkona Areas

Report on investigation on Karo group of Seams at Borehole NCBS-56, Sawang Block, East Bokaro Coalfield

Pilot plant investigations on potentialities of Ramgarh Coals — Second Report

Feasibility Report of Sudamdih coal washery project (Part II)

**NML**

Research and Investigation Papers (79 Nos.)

**CBRI**

Cost report on housing board bricks project, at Indore (Cyclostyled)

Bricks from Hyderabad soil

Mild steel twisted bar for concrete reinforcement

Wood based panel products and their application in buildings

Special bricks, Building Materials Note No. 6

**CMRS**

Studies on the Low Head Hydraulic Stowing plant in a coal Mine (Report No. 22)

Studies in the Leakage properties of underground stoppings (No. 24)

**RRL Jorhat**

Revised Plan for establishment of a 65 tons/day capacity pulp, paper and newsprint unit

Revised proposal for 9000 tons/year cement plant

**NGRI**

International Upper Mantle Project — Second progress Report of the Republic of India (Cyclostyled)

**PID**

Survey Report (No. 5) by RSPO

A study on the foreign exchange conservation by the National Laboratories (RSPO Survey Report No. 4), pp. 15

Research Potential & Science Policy of the People's Republic of China (RSPO Survey Report No. 7), pp. 39

Production of Binder from coal and Lignite Tars and Manufacture of Hand and Particle Boards, etc. from Timber and Agricultural Wastes

Washability Investigations on Talcher Seam coals from Deulbera and South Balanda Collieries

Report on investigation on Bermo Seam at NCBG-38, Govindpur Block, East Bokaro Coalfield

Report on investigation on Karo VIII Seam (or Karo Lower Measure) and other Seams at Boreholes NCBG-35 & 36, Govindpur Block, East Bokaro Coalfield

Report on investigation on Bermo Seam at NCBG-56, Sawang Block, East Bokaro Coalfield

A note on the requirements and availability of Washery byproduct fuels and of Raw Coals for the 1000 MW Power Station at Santhaldih

Airconditioning by Dehumidification Method using Karbogel — A new dessicant from coal found by CFRI

Report of investigation on Karo Group of Seams at Borehole NCBG-38, Govindpur Block, East Bokaro Coalfield

Report on investigation on Bermo Seam at Boreholes NCBK 21 & 23, Karo Prospecting Block, East Bokaro Coalfield

**CDEO**

Project Report for the Production of 1000 tonnes/annum of Syntans, based on the pilot plant work done at CLRI

Project Report for the Production of three types of Air Depolarized Cells (80,000/year of AWC-2 type, 40,000/year of AWC-1 type and 20,000/year of AW-4 type) based on the process developed at CECRI

Project Report for LTC for the Government of Maharashtra Feasibility Report on the Manufacture of graphite crucibles (600 tonnes/year) based on the work done at NML

**RSPO**

An analysis of foreign assistance to Scientific Research in India

**Technical Notes**

**CBRI**

George, J.—Effect of fire on building materials (Cyclostyled)

Rehsi, S. S.—Use of fly ash in reinforced concrete (Cyclostyled)

**CMERI**

Venkataraman, V.—Surface roughness measurement

Suri, M. M.—Scientific Research for the development of indigenous know-how

Swamy, S. G. N.—Prospects of ultrasonic tests of welds in India

Krishnamurthi, L.—The application of high frequency sound in fuel oil burners

Sampath, P.—Investigation on Helmhotz type tube combustor

Shrivastava, C. P.—Fabrication of economical structures

Das Gupta, S. & Dey, D.K.—A photometric comparator

Bhaduri, L. (Mrs)—An electronic instrument for measuring micro displacement

Shetty, K.V.—CMERI Research on industrial structures

**NAL**

Subramanian, N.R. & Dwarakanath, G.S.—Hypersonic flow around a blunt body real gas effects IN-AE-30-66

Gopinath, R.—On Maslen's solution for inviscid flow past blunt bodies, TN-AE-31-66

Basavaraju, B. & Shah, C.G.—Bending of thin elastic swept cantilever plates, TN-SA-7-66

Bose, T.K., Kalra, S.P. & Murthy, S.N.B.—Design charts for Nitrogen Plasma tube arc heaters, TN-PR-2-66

Rudraiah, N.—Magneto hydrodynamic transpiration cooling, TN-PH-4-66

**Technical Memoranda**

**NAL**

Desikan, K.S.—Deflection of the air-storage system Y-junction due to self weight, TM-AE-8-66

Jagannatha Rao, P.—The 3 in. × 4 in. Shock tube as a shock tunnel, TM-AE-9-66

Satyanarayana, B.—Aerodynamic design of NAL 4 ft Trisonic Wind Tunnel flexible plate supersonic nozzle, TM-AE-10-66

Kalra, S. P. & Irshad Ul Haque—Measurement of low mass flow rate of nitrogen gas, TM-PR-1-66

Narasimhaswamy, M. R.—Design of the AT-1 (Airturbine) system components, TM-PR-2-66

Janardhan, B. A.—Internal Gas-Thermodynamics of a solid propellant rocket motor, TM-PR-3-66

Mohan, A. N.—Development of ejector test-rig, TM-PR-4-66

Sridhara, K.—Compressed air requirements for the propulsion wind tunnel, TM-PR-5-61

Mohan, A. N. & Sridhara, K.—A note on the use of ejector exhausters in a propulsion wind tunnel, TM-PR-6-66

Thirumalaiswamy, S. N.—Method of prediction of unsteady performance of turbo-jet engines, TM-PR-7-66

Narasimhaswamy, M. R.—Design of the AT-1 (Airturbine) system and of the subsonic cascade tunnel, TM-PR-8-66

Seshagiri Hebbar, K.—Some parametric studies on a hypersonic shock tunnel, TM-PR-9-66

Nagabhushana, S. & Karunakar, M.—Test and adjustment of strip chart recorders, TM-SE-4-66

Balakrishna, S.—Design objectives for the 1 × 1 ft tunnel integrated controls, TM-SE-5-66

Seshabhushana Rao, B. S. & Srinathkumar, S.—Six-channel transducer amplifier, TM-SE-7-66

Srinathkumar, S. & Seshabhushana Rao, B. S.—Forty-eight-channel pressure measuring system for 1 × 1 ft Trisonic Wind Tunnel, TM-SE-8-66

Krishnamurthy, V. M. & Chandramohan, L. R.—Note on the construction of the 1-ft Trisonic Tunnel contraction in fibreglass reinforced plastic, TM-TC-3-66

**Engineering Reports**

The 4 × 4 ft Trisonic Tunnel hydraulic systems, NAL, ER-18-66

The 4 × 4 ft Trisonic Tunnel pneumatic system, NAL, ER-18-66

1 ft Trisonic Tunnel Pressure Regulating valve and its hydraulic control system, NAL, ER-19-66

**Technical Circulars and Information Letters**

**CGCRI**

Glass industry Nos. 7-9; Ceramic industry Nos. 7, 8 & 10; Refractories industry Nos. 7-11

**CLRI**

Upper Leathers— A process bulletin

**Miscellaneous**

A plan for popularization of soft coke and low volatile coals for Domestic use in Rural Areas in India (CFRI)

Memoirs 1965 (CECRI), pp. 297

Consumption of Domestic Fuels in Andhra Pradesh—A Survey Report (RRL Hyd.), pp. viii + 17

Industrial Processes, Regional Research Laboratory, Jorhat, (a souvenir) (RRL Jorhat), pp. 40

Guide Book (Bengali & Hindi) ( BITM)

Statistics on certain chemicals and chemical products for the years 1961-62 to 1964-65 (Statistical bulletin No. 1) (cyclostyled) (CSIR-ICMA)

Statistical data on Imported inorganic chemicals for the years 1961-62 to 1964-65 (Statistical bulletin No. 2) (cyclostyled) (CSIR-ICMA)

Statistical data on Imported Dyestuffs and Intermediates for the years 1961-62 to 1964-65 (Statistical bulletin No. 3) (cyclostyled) (CSIR-ICMA)

Statistical data on Imported organic chemicals for the years 1961-62 to 1964-65 (Statistical bulletin No. 4) (cyclostyled) (CSIR-ICMA)

Statistical data on Imported Pharmaceuticals for the years 1961-62 to 1965-66 (Statistical bulletin No. 5) (cyclostyled) (CSIR-ICMA)

Directory for chemicals and chemical products (CSIR-ICMA)

**Periodicals**

*Fortnightly*

Contents List—Current Engineering Literature (CMERI)

CSIR News (PID)

Documentation List (CBRI) (cyclostyled)

*Monthly*

Ionospheric Data (NPL)

Sunspot Number (NPL)

Food Technology Abstracts (CFTRI) (cyclostyled)

Library Bulletin (CFTRI) (cyclostyled)

CGCRI Documentation List (CGCRI)

Leather Science (CLRI)

Building Digests (CBRI)

Indian Science Abstracts (Insdoc)

Journal of Scientific & Industrial Research (PID)

Indian Journal of Chemistry (PID)

Indian Journal of Pure & Applied Physics (PID)

Indian Journal of Technology (PID)

Technical Manpower Bulletin (DSTP)

Vijnan Pragati (Hindi) (ILU)

Science Reporter (SRU)

T. I. C. C. I. News letter (CSIR : ICMA) (cyclostyled)

*Quarterly*

NPL Technical Bulletin (NPL)

Khadya Vignan (Hindi) (CFTRI)

Ahara Vijnana (Kannada) (CFTRI)

FRI News (CFRI)

CGCRI Bulletin (CGCRI)

NML Technical Bulletin (NML)

Thol Vignanam (Tamil) (CLRI)

Home Journal (CLRI)

CBRI Abstracts (CBRI)

Newsletter (CEERI)

Salt Research & Industry (CSMCRI)

Environmental Health (CPHERI)

Instrument News (CSIO)

Bulletin of the National Geophysical Research Institute (NGRI)

International Indian Ocean Expedition Newsletter (NIO)

Computer Centre Bulletin (SERC)

Annals of Library Science and Documentation (Insdoc)

Indian Journal of Experimental Biology (PID)

Indian Journal of Biochemistry (PID)

Research and Industry (PID)

*Half-yearly*

## Appendix 14

## PARTICIPATION OF LABORATORIES IN EXHIBITIONS

| *Laboratory* | *Exhibition* |
|---|---|
| NCL, CFRI, CECRI, CBRI, CMRS, RRL Hyd., RRL Jorhat, CSIO & NAL | 'Self-reliance through Science and Technology' organized by the Parliamentary & Scientific Sub-Committee in New Delhi (May 9-17, 1966) |
| NCL, CFRI, CECRI & RRL Jorhat | 'Our India' exhibition organized by the Union Ministry of Information & Broadcasting (Aug. 15, 1966) |
| NCL & RRL Hyd. | 'Small Industry Exhibition' organized by the Small Industries Service Institute, Bangalore (May 1966) |
| CSIO & NAL | Exhibition of instruments organized by the All-India Instrument Manufacturers' and Dealers Association, Bombay (Nov. 5-9,1966) |
| CFRI | Technical literature and models of some plants sent to British Association for the Advancement of Science Exhibition (July, 1966) and Expo'-67, Montreal, Canada; Second Industrial and Cultural Fair organized by the Railway Club, Dhanbad (Jan. 26 to Feb. 18, 1966) |
| CECRI | 'Permanent Small Industries Exhibition' at Bangalore (July 8, 1966); 'Science Fair' held by Diwan Dhajishaw High School, Jhagadia (Oct. 27-29, 1966); Exhibition arranged by the Mysore Chamber of Commerce, Bangalore (May 26-31, 1966) |
| CLRI | Indian Leather Fair at Madras (Jan. 27 to Feb. 7, 1966) |
| CBRI | Exhibition organized by Planning Forum of Regional Engineering College, Tiruchirappalli; Building Industry Exhibition at Ahmedabad; Exhibition organized by the Municipal Board, Hanumangarh; Exhibition on 'State's Projects in Five-Year Plans of M. P. State (Dec. 16, 1966) |
| CSMCRI | Sent exhibits to Expo'-67 Exhibition to be held in Montreal, Canada, in 1967 |
| CMRS | Industrial Fair at the Railway Club, Dhanbad (Feb. 16 to March 5, 1966); 'Bihar through the Plans' at Patna (May 14 to July 31, 1966) |
| BITM | Mobile Science Exhibition in Museobus (Dec. 26, 1966); Bangiya Bigyan Parishad, Calcutta (Feb. 12-20, 1966); 'Science for Children', Rabindra Sarobar, Calcutta (April 13-19, 1966); Picnic Park Recreation Club, Calcutta (July 17-23, 1966); Hooghly Institute of Technology, Calcutta (Sept. 15-18, 1966); Science Exhibition at BITM (May 3-10, 1966) |
| CSIO | Exhibition during the first convocation of the Indo-Swiss Training Centre (Aug. 13, 1966) |
| NAL | Scientific and Industrial Exhibition sponsored by the Madurai University in connection with the Annual Session of Indian Academy of Science (Dec. 18-27, 1966) |
| VITM & BITM | 'Sample Science Museum' at New Delhi on the occasion of Unesco Regional Seminar on 'Development of Museums' Jan. 31 to Feb. [illegible] Exhibiting a model on 'Street lighting' at Bangalore |

## Appendix 15

## VISITORS

**NCL**

Dr J. V. Narlikar, University of Cambridge, UK — Feb. 2, 1966

Prof. G. Fodor, University of Laval, Canada — Feb. 2, 1966

Prof. J. H. Quaste, University of Montrieal, Canada — Feb. 5, 1966

Prof. M. Fetizon, University de Paris, Dorsay, France — March 2, 1966

Dr O.N. Tolkachev and Dr Grenevitch, Russian Scientists — March 14, 1966

Prof. Friedrich, Jung, Scientist, GDR — April 1-5, 1966

Prof. V. M. Juchkevich, Professor of Physics and Mathematics, Academy of Sciences, USSR — April 6, 1966

Dr N. Blakebrough, Birmingham University, UK — April 19, 1966

Prof. W. Kern, Director, Institute of Organic Chemistry, University of Mainz, West Germany — Sept. 15, 1966

Prof. F. C. Happold, Department of Biochemistry, University of Leeds, UK — Oct. 21, 1966

Prof. Varsanyi Gyorgy, Head of the Department of Physical Chemistry, Budapest — Oct. 30, 1966

Prof. E. W. Fischer, University of Mainz, West Germany — Oct. 27, 1966

**NPL**

Prof. V. M. Tuchkevich, Professor of Physics & Mathematics, and Chief, Laboratory of Semiconductors, Academy of Sciences, USSR

Prof. M. Balkansik, Faculty of Sciences, Paris University and Director, Physical Laboratory, Ecole Nationale Superieure, Paris

Prof. William Paul, Harvard University, USA

Prof. J. S. Dryden, CSIRO, Sydney, Australia

**CFTRI**

Dr V. A. Ogarev and Dr B. G. Erchov, Institute of Physical Chemistry, Moscow — Feb. 21, 1966

Dr Edward Ross, Department of Food Science and Technology, College of Tropical Agriculture, University of Hawai — March 4, 1966

Mr C. G. Tucker, FAO Expert on Freeze Drying — June 17-23, 1966

Dr A. M. Gede, Regional Adviser on Maternal and Child Health, WHO — Sept. 13, 1966

Prof. Paul M. Newberne, Professor of Nutritional Pathology, Massachusetts Institute of Technology, USA — Nov. 17, 1966

**CGCRI**

Mr A. A. Abzikosov, Institute for Theoretical Physics, Academy of Sciences, USSR — Jan. 1, 1966

Mr Victor Silin, Lebedevls Institute, Academy of Sciences, USSR — Jan. 1, 1966

Dr Jaroslov Pluhar, Czechoslovak Academy of Sciences, Prague — Jan. 1, 1966

Mr R. Abell and Mr A. Sennhauser, Unesco Experts — Jan. 18, 1966

Prof. V. M. Tuchkervich, Scientist, USSR — April 13, 1966

**NML**

Dr A. M. Shams El Din, Director, National Research Centre, UAR — Jan. 14, 1966

Prof. Y. P. Filimonov, Unesco Expert and Specialist in Furnace Design — Feb. 10, 1966

Dr Donald McClean, National Physical Laboratory, Teddington; Prof. Zdenek Eminger, Chief Technical Adviser, Branch Metallurgie, Unesco, Paris and Mr Starasta, Czech Expert, Heavy Engineering Corporation, Ranchi — Sept. 22-23, 1966

**CDRI**

Dr Ivan Lesny, Neurological Teaching Hospital, Prague — Jan. 1, 1966

Dr K. H. Ginzel, Riker Laboratories, USA — Jan. 1, 1966

Dr Emilio Testa, Director, Lepetit s.p.a., Milano, Italy — Feb. 2-3, 1966

Dr G. Fodor, Professor of Organic Chemistry, Faculte des Sciences, Universite Laval, Quebec, Canada — Feb. 4-5, 1966

Dr Morizo Ishidate, Director, National Institute of Hygienic Sciences, Tokyo — Feb. 7, 1966

Dr Randall H. Thompson, National Institute of Health, USA — Feb. 14, 1966

Dr I. A. Gubanov, Dr A. S. Gladkih and Dr I. M. Rabinovich, Scientists, Institute for Medicinal Plants, Moscow — Feb. 28, 1966

Prof. Dr Friedrich Jung, Director, Institute of Pharmacology, Berlin and Member, Academy of Sciences, GDR — March 3-23, 1966

Dr Patricia Carpenter, Director, Dysentery Reference Laboratory, Central Publich Health Laboratory, Colindale, UK — April 4-8, 1966

Dr Ernerst Wenker, Professor of Organic Chemistry, Indiana University, Blomington, USA — April 20, 1966

Prof. V. G. Khrjanovsym, Professor of Biological Sciences, Timiriaze Agricultural Academy, Moscow, USSR — August 30, 1966

Dr Christian Lehman, Director, Institute of Cultivated Plants, Gartesleben, GDR — Nov. 1, 1966

Dr Murle W. Klohs, Director, Medicinal Chemistry Section , Riker Laboratories, Northridge, California, USA — Nov. 2, 1966

Dr K. Repke, Director, Institute of Biochemistry, East Berlin — Nov. 7, 1966

Dr John M. Venditti, Chief Drug Evaluation Branch, CCNSG, National Institute of Health, Bethesda, USA — Nov. 8-11, 1966

Dr Philip Corfman, Head, Reproduction Programme, NIH, Bethesda, Maryland, USA — Dec. 8, 1966

Dr D. R. Sanadi, Director, Department of Bioenergetics Research, Retina Foundation, Boston, USA — Dec. 15-17, 1966

**CRRI**

Dr S. R. Sparkes, Imperial College, London — Nov. 9, 1966

Prof. Brohult, President, Royal Academy of Technical Sciences, Stockholm, Sweden — Nov. 18, 1966

Mr Yakolev Nikolai & Mr Hans D. Doscher, UN Experts — Nov. 23, 1966

**CECRI**

Prof. K. V. Saprykin, Unesco Expert, Indian Institute of Technology, Bombay—Sept. 26, 1966

**CLRI**

Dr H. El Sissi, Assistant Professor, Tanning Unit, National Research Centre, Cairo, UAR — Jan. 18, 1966

Dr V. R. Ogarev and Dr V. G. Ershov, Institute of Physical Chemistry, Moscow, USSR — Feb. 25, 1966

**CBRI**

Mr Larry Wright, Brandon, South Dacota, USA — Feb. 2, 1966

Mr S. Qamar Hussain, UN Adviser, Special Fund Project — March 11, 1966

Prof. J. Schwaighofer, University of Toronto, Canada — June 30, 1966

Prof. R. G. Hannes, University of Wach, Scattle, USA — June 30, 1966

Prof. W. M. Haas, Michigan Technological University, Michigan, USA — June 30, 1966

Mr G. D. Ding, University of Sydney, Sydney, Australia — July 28, 1966

**NBG**

Dr A. G. Sladkihm, Dr J. A. Gubanov & Dr J. U. Rabinovich, All Union Scientific Research Institute of Aromatic and Medicinal Plants, Moscow — Feb. 28 to March 3 1966

Dr Robert J. Rodin, Associate Professor of Biological Sciences, California State Polytechnic College, USA and Prof. V. Nojnaansky, Institute of Experimental Phytopathology and Entomology, Academy of Sciences, Czechoslovakia — Sept. 29, 1966

Dr S. V. Meyen, Geological Institute of the Academy of Sciences, USSR — Oct. 26, 1966

**CMRS**

Mr Boegan, Chief Engineer, Detonator Factory, Hungary — Feb. 11, 1966

Mr Yrista, Chief Engineer Nitrokenva (Explosive) Factory, Hungary — Feb. 11, 1966

Prof. Y. F. Makogon, Moscow Institute of Petrochemical and Gas Industry, Guest Professor in Indian School of Mines — March 17, 1966

Mr C. E. Taylor, University Illinois, Urbana, USA — June 22, 1966

Mr T. Soejima, Mitsu Mining Co. Ltd, Tokyo — July 30, 1966

Prof. A. J. Hargraves, University of Sydney, Australia — Oct. 27, 1966

**RRL Hyd.**

Dr J. T. Wilson, Director, Institute of Earth Sciences, University of Toronto, Canada — Jan. 1, 1966

Dr Cook, National Research Council of Canada, Ottawa, Canada — Jan. 11-12, 1966

Dr D. S. Murray, Group Pathologist, Kingston Hospital, Surrey, England — Jan. 19, 1966

Dr Herbert Borison, Professor of Pharmacology, Darmouth Medical School, New Hampshire, USA — Jan. 24-30, 1966

Dr J. R. Boissier, Professor of Pharmacology, Faculte de Medicine, Institut de Pharmacologie, Paris, France — Jan. 24-30, 1966

Dr P. B. Bradley, Professor and Head of the Department, Department of Experimental Neuropharmacology, The Medical School, Birmingham, UK — Jan. 24-30, 1966

Dr G. Fodor, Professor of Organic Chemistry, Universite Laval, Faculte des Sciences, Quebec, Canada — Jan. 24-30, 1966

Dr E. E. Hays, Vice-President, Research, Riker Laboratories, Northridge, California, USA — Jan. 24-30, 1966

Dr E. L. May, Scientist-Director and Chief of the Medicinal Chemistry Section, National Institute of Health, Maryland, USA — Jan. 24-30, 1966

Dr M. Medakovic, Head, Department of Pharmacology and Toxicology, Faculty of Medicine, Novi Sad, Yugoslavia — Jan. 24-30, 1966

Dr Carl C. Pfeiffer, Head, Neuropharmacology Section, New Jersey Neuro-Psychiatric Institute, Princeton, New Jersey, USA — Jan. 24-30, 1966

Dr M. Protiva, Head, Chemical Division, Pharmaceutical and Biochemical Research Institute, Czechoslovakia — Jan. 24-30, 1966

Dr Otto Schaumann, Innsbruck (Osterreich) Peter Mayster I, Austria — Jan. 24-30, 1966

Dr G. Schenck, Professor and Director, Pharmazeutisches Institut, Freie University, Berlin — Jan. 24-30, 1966

Dr Emil Schlitter, Executive Vice-President, Research and Production, CIBA Pharmaceutical Company, Summit, New Jersey, USA — Jan. 24-30, 1966

Dr B. Vithal Shetty, Head, Department of Organic Chemistry, Strassenburgh Laboratories, Rochester, New York, USA — Jan. 24-30, 1966

Dr L. H. Sternback, Research Division, Hoffmann-La Roche Inc., New Jersey, USA — Jan. 24-30, 1966

Dr Emilio Testa, Director, Lepatit s.p.a. Milano, Italy — Jan. 24-30, 1960

Dr V. R. Ogarev, Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR — Feb. 14, 1966

Dr V. G. Ershov, Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR Feb. 14, 1966

Dr Wollgiehn, Institute of Plant Biochemistry, Halle, GDR — March 14-21, 1966

Dr D. A. Riad Tourkey, President, Supreme Council of Scientific Research, UAR — May 4, 1966

Dr Abdel A. Sabet, Director-General, Department of Scientific Relations, Supreme Council of Scientific Research, UAR — May 4, 1966

Dr Felipe L. Santillan, National Institute of Science and Technology, National Science Development Board, Manila, Philippines — May 7, 1966

Dr Melak H. Mengesha, Haile Selassie I Univ. Debre Zeit, Ethiopia — May 7, 1966

Dr L. A. Sauger, Director Du Centre de Recherches Agronomiques, Bambey (Senegal) — May 7, 1966

Dr Paul Friedlander, Academy of Sciences, Institute of Economic Sciences, Berlin, GDR — May 7, 1966

Dr Alain H. Gille, Director, Unesco Regional Centre for Science and Technology for Africa, Nairobi, Kenya — May 7, 1966

Dr W. P. Napitupulu, Head, Bureau of Research Grants, Ministry of National Research, Djakarta, Indonesia — May 1966

Dr K. Vedam, Materials Research Laboratory, Pennsylvania State University, USA — July 28, 1966

Dr David Tremthem, Biochemistry Department, University of Bristol, UK — Aug. 18-28, 1966

Mr Maurice Goldsmith, Director, Science of Science Foundation, London — Aug. 23-24, 1966

Prof. Vit Bojnansky, Senior Research Officer and Head, Mycological and Virological Department, Institute of Plant Cultivation, Slovak Academy of Sciences, Bratislava, Czechoslovakia — Oct. 15-17, 1966

Dr F. R. Senti, US Dept of Agriculture, Washington D.C., USA — Oct. 28, 1966

Dr & Mrs J. Bronowski, Deputy Director, The Salk Institute for Biological Studies, California, USA — Oct. 30 to Nov. 2, 1966

Mr E. Klohs, Director, Medicinal Chemistry, Riker Laboratories, Northridge, California, USA — Nov. 5-8, 1966

Dr Ian A. Mitchell, Associate Scientific Director for Planning & Analysis, Etiology, National Cancer Institute, Bethesda, USA — Nov. 15-17, 1966

Prof. E. Boyland, Professor of Biochemistry, Chester Beatty Research Institute, Institute of Cancer Research : Royal Cancer Hospital, Fulham Road, London

Dr & Mrs George de Stevens, Director, Chemical Research Division, CIBA Pharmaceutical Company, Summit, New Jersey, USA — Dec. 11-12, 1966

Dr S. R. Sanadi, Director, Department of Biogenetics Research, Retina Foundation, Boston, USA — Dec. 18-21, 1966

**RRL Jammu**

Dr I. A. Glubonov, Dr I. M. Rabenevitch & Mr A. S. Gladkih, Russian Scientists — March 27 to April 3, 1966

Prof. Friedrich Jung, Director, Institute of Pharmacology, German Academy of Sciences, Germany — April 30, 1966

Mr Maurice Goldsmith, Director, Science of Science Foundation, London — Sept. 14-17, 1966

**RRL Jorhat**

Prof. Vit Bojnausky, Slovak Academy of Sciences, Bratiscava, Czechoslovakia — Oct. 10, 1966

Dr C. R. Gotellier, Institute Francais du Petrole, Paris — Nov. 7, 1966

Mr Nessim Shallon, Deputy Resident Chief, UN Development Programme, New Delhi — Dec. 27, 1966

Dr A. F. Daldy, Building Research Station Garston, Herts, UK — Nov. 3, 1966

Prof. A. Kezdi, Technical University, Budapest, Hungary — Dec. 1, 1966

Dr Ing. M. Kozeg, Technical University, Budapest, Hungary — Dec. 8, 1966

Mr D. J. Vickey, Senior Unesco Expert, Asian Regional Institute of Building Research, Colombo — Dec. 10, 1966

**IIEM**

Prof. J. Bronowski, Deputy Director, The Salk Institute for Biological Studies, California — Nov. 7, 1966

**BITM**

Mr Joseph A. Patterson, Director, American Association of Museums, USA — Feb. 20,1966

Dr J. P. Harding, Keeper of Zoology, British Museum, London — Aug. 12, 1966

Dr Maurice Goldsmith, Director, Science and Science Foundation, London — Sept. 4, 1966

**CPHERI**

Mr Szuman, Unesco Expert — Jan. 3, 1966

Mr E. W. Surber, Water Pollution Expert, FAP/TA Project — Oct. 14-15, 1966

**CMERI**

Dr Ing. Herbert Heitland, Visiting Professor, Indian Institute of Technology, Madras — Jan. 15, 1966

Prof. V. R. Soldatenko, Visiting Professor, Indian Institute of Technology, Bombay — March 10-14, 1966

Mr A. B. Harland, Chief, Industry & Technology Section, UN Development Programme, New York — Aug. 4-5, 1966

Prof. F. W. Hutchinzon, Visiting Professor, Department of Mechanical Engineering, Indian Institute of Technology, Kanpur — Sept. 20, 1966

Dr Ing. F. H. Zalud, Automobile Engineer, Motor Car Research Institute, Czechoslovakia and Member, Czechoslovak Academy of Sciences, Prague — Nov. 18-19, 1966

**CSIO**

Prof. P. M. S. Blackett, Professor of Physics, Imperial College of Science and Technology London — Jan. 3. 1966

Prof. V. A. Fock, University of Leningrad; and Prof. V. P. Sillin, P. N. Lebedev Institute of Physics, Moscow — Jan. 4, 1966

Prof. F. Paul, Central Research Institute of Physics, Budapest — Jan. 7, 1966

Dr David Owe, UN Development Programme, New York and Dr A. G. Evstafiev, Chief of Unesco Mission in India, New Delhi — Feb. 11, 1966

Dr C. G. Wynne, Director, Optical Design Group, DSIR, UK — Feb. 28, 1966

Dr B. G. Erchov and Dr V. A. Ogarev, Institute of Physical Chemistry, Moscow — March 4, 1966

Dr J. Mc Divitt, Department of Application of Science to Development, Unesco Headquarters and Dr F. J. C. Pala, Deputy Director, Office of the Chief Mission in India and South Asia, Science Cooperation Office, New Delhi — April 5, 1966

Prof. J. V. Ramsay, CSIRO, Division of Physics, National Standards Laboratory, Sydney, Australia — April 22, 1966

Dr M. Shehata Farag, Head of the Physics Department, National Research Centre, Dokki, Cairo, UAR — May 17, 1966

Mr S. Hakansson, Unesco Adviser on Fine Mechanics, Manila, Phillipines — June 28, 1966

Dr R. V. Allenstein, Washington University, USA and Mr Rom Strickler, Department of Physics, Berea College, Borea, USA — July 2, 1966

Mr L. R. Davis, California, USA and Mr H. C. Preul, University of Cincinnati, Ohio, USA — July 4, 1966

Dr G. Zuckerman, Unesco Expert — July 15, 1966

Prof. H. N. Hayward, University of Illinois, Illinois, USA — July 18, 1966

Dr D. R. Sanadi, Director of the Department of Bioenergetics Research, Retina Foundation, Boston, USA — Dec. 12, 1966

**IIP**

Prof. P. J. Garner, Birmingham University, UK, Mr G. H. Visser, Shell Research Group, Holland and Prof. Alexander G. Sardanashvilli, USSR, Unesco Consultative Commission Experts

**NAL**

Dr A. R. Turkery, Chairman, Supreme Council of Scientific Research, UAR — May 5, 1966

Dr Ing. F. H. Zalud, Motor Car Research Institute, Czechoslovakia, and Member, Czechoslovakia Academy of Sciences — Nov. 24, 1966

**NGRI**

Prof. K. Smulikowski and Prof. I Malaecki, Polish Academy of Sciences — Feb. 1966

Dr V. R. Ogarev and Dr C. G. Erchov, Institute of Physical Chemistry, Moscow — February 1966

Dr Kendall L. Scendsen, Geomagnetism Division of US Coast and Geodetic Survey, US Department of Commerce, USA — July 1966

Dr A. S. Gritzaenko, Unesco Consultant in Geophysics — October 1966

Dr S. T. Algermissen, Chief, Geophysics Research Group, Rockville, USA — November, 1966

**NIO**

Prof. J. Krey, Institute Fur Meereskunde, University of Kiel, Germany and Prof. Michitaka Uda, Tokyo University, Japan — Sept. 1, 1966

**SERC**

Dr Waclaw Olszak, Member, Polish Academy of Sciences, Warsaw, Poland — June 3, 1966

Prof. C. Berg, Director International Computation Centre, Rome — June 18, 1966

Prof. Gerald Pickett, Visiting Professor of Applied Mechanics, University of Wisconsi — July 22, 1966

Prof. Joseph Schwaighhofer, University of Toronto — June 30, 1966

Dr G. D. Ding, Senior Lecturer in Architectural Sciences, University of Sydney, Sydney — July 28, 1966

**CSIR Secretariat, New Delhi**

Dr J. V. Narlikar, King's College, Cambridge, UK — Jan. 1 to Feb. 2, 1966

Dr & Mrs Hays, Riker Laboratories, California, USA — Jan. 25-27, 1966

Dr I. A. Glubonov, Dr I. M, Rabinovitch and Mr A. S. Gladkin, Institute for Medicinal Plants, Moscow — Feb. 23, 1966

Mr R. Navarre, Chairman, Institute Francais du Petroleum, France — May 16-22, 1966

Prof. A. K. Ramdas, Purdue University, Indiana, USA — June 1966

Dr W. Olszak, Member, Polish Academy of Sciences, Warsaw, Poland — May 5, 1966

Mr Maurice Goldsmith, Director, Science of Science Foundation, UK — August 19, 1966

Dr Christian Lehmann, Director, Institute for Cultivated Plants, Gatersleben, GDR — Oct. 18, 1966

Prof. Robert J. Rutman, University of Pennsylvania, USA — Nov. 5, 1966

Dr Wiktor Kemula, Scientist, Poland — Nov. 8, 1966

Prof. J. Bronowski, Deputy Director, The Salk Institute for Biological Studies, San Diego, California, USA — Nov. 17, 1966

Dr Ing. F. H. Zalud, Automobile Engineer, Motor Car Research Institute and Member, Czechoslovak Academy of Sciences, Prague — Dec. 1-2, 1966

## Appendix 16

## NATIONAL LABORATORIES/INSTITUTES RECOGNIZED BY INDIAN UNIVERSITIES FOR POST-GRADUATE STUDY AND RESEARCH

| *Laboratory* | *University* |
|---|---|
| NCL | Agra, Andhra, Banaras, Bombay, Madras, Panjab, Poona, Vikram |
| NPL | Agra, Aligarh, Andhra, Banaras, Baroda, Bombay, Delhi, Jadavpur, Karnatak, Kerala, Madras, Nagpur, Panjab |
| CFTRI | Andhra, Agra, Bangalore, Banaras, Bombay, Karnatak, Kerala, Madras, Mysore, Nagpur, Panjab, Poona |
| CFRI | Agra, Aligarh, Andhra, Banaras, Baroda, Bombay, Calcutta, Jadavpur, Kerala, Nagpur, Ranchi, Rajasthan |
| CGCRI | Agra, Andhra, Banaras, Calcutta, Karnatak, Panjab, Ravishankar |
| NML | Agra, Andhra, Banaras, Bihar, Bombay, Jadavpur, Madras, Panjab, Utkal, Ranchi, Sri Venkateswara |
| CDRI | Agra, Aligarh, Andhra, Banaras, Baroda, Bombay, Calcutta, Karnatak, Kurukshetra, Lucknow, Madras, Panjab, Poona, Rajasthan, Vikram |
| CRRI | Delhi, Roorkee |
| CECRI | Agra, Aligarh, Andhra, Banaras, Bhagalpur, Bombay, Karnatak, Kerala, Madras, Osmania, Panjab, Rajasthan, Sri Venkateswara, Vikram |
| CLRI | Aligarh, Banaras, Baroda, Gujarat, Rajasthan |
| CBRI | Agra, Banaras, Bombay, Panjab, Poona, Roorkee |
| NBG | Agra, Aligarh, Banaras, Gauhati, Karnatak, Kerala, Lucknow, Panjab, Poona, Rajasthan |
| CSMCRI | Andhra, Banaras, Baroda, Bombay, Gujarat, Karnatak, Panjab, Rajasthan, Sardar Vallabhbhai Vidyapeeth, Shivaji |
| CMRS | Banaras, Burdwan, Calcutta |
| RRL Hyd. | Agra, Aligarh, Andhra, Banaras, Baroda, Bombay, Calcutta, Gujarat, Kerala, Madras, Mysore, Nagpur, Osmania, Poona, Punjabi, Rajasthan, Utkal, Vikram |
| RRL Jammu | Aligarh, Baroda, Bombay, Gujarat, Jammu-Kashmir, Karnatak, Kerala, Kurukshetra, Panjab, Rajasthan, Utkal, Vikram |
| RRL Jorhat | Gauhati |
| IIEM | Calcutta, Panjab |
| CPHERI | Banaras, Baroda, Bombay, Jadavpur, Karnatak, Nagpur, Roorkee, Utkal |
| CSIO | Agra |
| IIP | Agra, Banaras, Bombay, Calcutta |
| NAL | Andhra, Banaras, Baroda, Bombay, Gujarat, Kerala, Kurukshetra, Madras Mysore, Poona, Panjab, Roorkee, Sardar Vallabhbhai Vidyapeeth, Sri Venkateswara, Vikram, Inter-University Board of India and Ceylon |

## Appendix 17

## SYMPOSIA, SEMINARS, CONFERENCES, SUMMER SCHOOLS

### Symposia

Molecular genetics—Feb. 11, 1966; RRL Jammu

Cultivation and utilization of medicinal and aromatic plants—March 18-19, 1966; RRL, Jammu

Recent advances in the development, production and utilization of medicinal and aromatic plants—April 18-20, 1966; CIMPO

Metallurgy of substitute ferrous and non-ferrous alloys—April 27-30, 1966; NML

Coastal and near shore oceanography—Dec. 4-5, 1966; NIO

Community water supply and waste disposal—Dec. 19-21, 1966; CPHERI

Control of fertility—April 7-8, 1966; CDRI (PDRC)

### Seminars

Physics teachers seminar—March 11-15, 1966; NPL

Hydrogen production and utilization in petroleum refining and petrochemical industries —March 19-21, 1966; IIP

Rural housing—March 25, 1966; CBRI

Electronic instrumentation—April 29 to May 1, 1966; CEERI

Opportunities for new industries—May 28-30, 1966; CIMPO

Resession in the textile industry—July 1, 1966; SITRA

Multi-storeyed housing for low income group—Aug. 26, 1966; CBRI

Competitive students' seminar—Sept. 19 , 1966; BITM

Work-flow in special libraries—Nov. 21-24, 1966; Insdoc

Electrochemistry—Dec. 27-30, 1966; CECRI

### Conferences

Tanners Get-Together—Jan. 31 to Feb. 4, 1966; CLRI

Conference of Directors and Heads of National Laboratories/Institutes of CSIR—July 4-5, 1966; NAL

Eighth conference on 'Human Relation in Industry'—Aug. 19-20, 1966; SITRA

Get-Together of cable industry—Jan. 28-31, 1967; CMERI

### Summer Schools

Mine planning—June 10-13, 1966; CMRS

Electronic control—June 13 to July 2, 1966; CEERI

## Appendix 18

### PILOT PLANTS INSTALLED

| | | |
|---|---|---|
| NCL | 1. | Phthalate (25 kg./batch) |
| | 2. | Design cell |
| | 3. | Chlorination of ethylene (100–150 kg./hr of chloro compound) |
| CFRI | 4. | Coal fertilizer plant (2 tonnes/day) |
| | 5. | Purification plant for phthalic anhydride (125 kg./day) |
| | 6. | A briquette curing pilot plant for hardening briquettes by heat treatment (1/2 tonne/day) |
| CRRI | 7. | Prestressed concrete pavements |
| | 8. | Pulverization of black cotton soil |
| CLRI | 9. | Sports goods leather |
| | 10. | Sharkskin leather |
| CSMCRI | 11. | H. D. Unit for desalination of seawater (5000 litres/day) |
| | 12. | Solar stills |
| | 13. | Electrodialysis unit for desalting of brackish water (1500 litres/day) |
| | 14. | Semi-commercial plant to produce potassium chloride and epsom salt at Kandla (3 tonnes of KCl and 7 tonnes of epsom salt/day) |
| | 15. | Borax from Pugga Valley tincal (450 kg./8 hr) |
| | 16. | Washery unit for salt disperse washing column type (400 kg./hr) |
| | 17. | Sorel cement tiles (200 tiles/8 hr) |
| | 18. | Magnesia insulation pipe sections (100 r.f.t. pipe section/khr) |
| | 19. | Ethylene dibromide (12 kg./day) |
| RRL Hyd. | 20. | Briquetting unit (200 kg./day) |
| | 21. | Benzyl acetate and benzyl alcohol (225 litres/day) |
| | 22. | Continuous type solvent extraction plant (10 tonnes/day) |
| RRL Jammu | 23. | Citric acid (50 kg./batch) |
| | 24. | A pilot plant for the extraction, isolation and purification of total alkaloids in a plant (50 kg./batch) |
| RRL Jorhat | 25. | Dry yeast from petroleum hydrocarbons (1000 kg./day) |
| | 26. | Deinking of newspapers (0.5 ton/day) |
| | 27. | Iron from iron ore fines (3 tons/day) |
| CPHERI | 28. | Sludge digester (100,000 gal./day) |
| | 29. | Defluoridation pilot plant (10,000 gal/day) |
| | 30. | Oxidation ditch (6,000 gal./day) |
| IIP | 31. | Town gas from naphtha (500 $Nm^3$/day) |
| | 32. | Reforming of iomex (1 tonne/day) |
| | 33. | Hydrocracking unit |

## Appendix 19

### SCHEMES SPONSORED BY OUTSIDE ORGANIZATIONS

| *Laboratory and project* | *Sponsor* |
|---|---|
| **NCL** | |
| **Schemes completed** | |
| Process for the manufacture of a synthetic drug | |
| Process for the manufacture of a vat dye | |
| Preparation of reactive dyes | |
| Process for the manufacture of a synthetic dye | |
| Studies in pine oil from Indian turpentine oil | |
| **Schemes in progress** | |
| Work on investigations on the synthesis and properties of new type glycol monoalkyl ethers for the control of water evaporation to extend the industrial utilization of cotton seed oil | P.L. 480, US Dept of Agriculture |
| Chemical and thermodynamic properties of refractory materials at high temperature | National Bureau of Standards, Washington |
| Investigation of the effect of heat on tung oil and derivatives of tung oil and the characterization and identification of compounds resulting from heat treatment to extend the utilization of tung oil | P.L. 480, US Dept of Agriculture |
| Production of titanium tetrachloride from ilmenite | M/s Travancore Titanium Products Ltd, Trivandrum |
| Electron diffraction camera | Gauhati University, Fertilizer Corporation of India, Sindri and Defence Science Laboratory, New Delhi |
| Lac dye | Indian Lac Cess Committee, Ranchi |
| Popularization of commercial uses of costus roots (Kuth) grown in India | Govt of Punjab |
| Composite drug research scheme on Indian medicinal plants | Ministry of Health, Govt of India |
| Constitution of lac | Indian Lac Research Institute, Ranchi |
| Calcium hypophosphite | |
| Improvements in the process for the manufacture of l-menthol from dementholized peppermint oil | |
| Sodium cyclamates | |
| Isolation of emetine from ipecac roots | |
| Carbimazole | |
| Sorbide nitrate | |
| **New schemes** | |

| *Laboratory and project* | *Sponsor* |
|---|---|
| Preparation of nonyl phenol | |
| Preparation of calcium silicate | |
| Industrial chemicals from diketene | |
| Vanillin and tehyl vanillin | |
| Chlorinated copper phthalocyanines | |
| Manufacture of benzoic acid | |
| Investigation of a fermentation problem | |
| Preparation of aminotriazole | |
| Development of manufacturing processes for rayon grade pulp from some species of wood | |
| Radio opaque dyes like urografin and biligrafin | |
| Utilization of longifolene | |
| Utilization of $\triangle^3$-carene | |
| Utilization of terpene-G | |
| Sulphacetamide and its sodium salt | |
| Anthraquinonoid intermediates and dyes | |
| Preparation of BD-catalyst | |

**NPL**

**Schemes in progress**

| | |
|---|---|
| Crystal growth | P.L.. 480 |
| Study of F-layer effects with Doppler fading technique | do |
| Physical properties and irradiation effects on ionic crystals and semiconductors | do |

**New scheme**

| | |
|---|---|
| Ferromagnetism and ferroelectricity | P.L. 480 |

**CFRI**

**Schemes in progress**

| | |
|---|---|
| Washability investigations on coals from Noonidih Washery project in Jharia coalfield | National Coal Development Corporation Ltd |
| Preparation of hydraulic sand-stowing scheme for Kargali Colliery, East Bokaro coalfield | do |
| Washing of Ramgarh coals in prototype plant scale in connection with Ramgarh project | do |
| High temperature carbonization of Ramgarh Block I coals in blends with Dugada I and II schedule coals | do |
| Bulk washing tests of Ramgarh coals in prototype plant for Ramgarh project | do |
| Carbonization tests on Ramgarh block I (Top and bottom [illegible] coalfield | do |

| *Laboratory and project* | *Sponsor* |
|---|---|
| Evaluation of performance of Bhojudih washery | Union Ministry of Mines and Metals |
| Washability investigations of XII seam coal from Huriladih colliery, Jharia coalfield | Macheil & Barry Ltd, Dishergarh |
| Sampling and carbonization of Kanhan valley coals | Government of Maharashtra |
| Field study of Kargali Seam at Kothara Colliery of NCDC for drawing bulk samples for washability investigations | Bokaro Steel Ltd |
| Bulk washing tests on Dugada II coals in prototype plant | Hindustan Steel Ltd |
| Recovery and analysis of middlings from Kathara coal, East Bokaro coalfield | Bokaro Steel Ltd |
| Carbonization tests on coals from Rakhicole Damua and Kalichaapar areas of Kanhan Valley coalfield | Government of Maharashtra |
| Production of active carbon from coconut shell by CFRI method | Shri K. V. Gopalakrishnan Calicut, Kerala |

**NML**

**Schemes in progress**

| | |
|---|---|
| Flotation studies on a copper ore sample from Rakha mines | National Mineral Development Corporation Ltd, Faridabad |
| Pilot plant studies on beneficiation and sintering of a sample of hydroxide ore from Dalli mines of Hindustan Steel Ltd | Hindustan Steel Limited |
| Investigation on the use of pyrophyllite as a refractory material | |
| Beneficiation studies on a copper ore sample from shaft No.3 Khetri, Rajasthan | National Mineral Development Corporation Ltd, Faridabad |
| Beneficiation and sintering studies on a sample of iron ore from Maghatabury mines | do |
| Reduction of silica content of a magnesite sample from Salem, Madras | |
| Pilot plant studies on beneficiation and sintering of a mixed laminated iron ore sample from Rajasthan mines of Bhilai Steel Plant | Hindustan Steel Ltd |
| Investigation report on the utilization of blended coke containing Assam coal for iron making | |
| Beneficiation and sintering studies with mixed sample of massive and laminated iron ore from Rajhara mine of Bhilai Steel Plant | Hindustan Steel Ltd |
| Beneficiation of a low grade iron ore from Goalpare | |
| Beneficiation of calcite from Sankaridurg, Madras | |
| Beneficiation of an iron ore sample from Kundrekuh deposits, Mysore | |
| Studies on sintering of Bhawanathpur dolomite for its suitability as a refractory material | |
| Beneficiation of low grade limestone sample | |
| [illegible] of high carbon ferrochrome and silicochrome | |

| *Laboratory and project* | *Sponsor* |
|---|---|
| Reduction of insoluble content of a selenite sample from Rajasthan | |
| Pilot plant beneficiation studies on a low grade mixed apatite sample from Singhbum District, Bihar | |
| Concentration of cobalt bearing ferrous manganese ore from Kalahandi, Orissa | |
| Beneficiation of graphite | |
| Reduction of iron content in a magnesium ore sample | |
| Sintering of Bellary Hospet area | |
| Sintering of iron ore | |
| Beneficiation of Kyanite | |
| Recovery of zinc from zinc dross | |
| Removal of mica from Jamuna river sand | |

**CDRI**

**Scheme completed**

| | |
|---|---|
| Study of sterility in laboratory animals | Indian Council of Medical Research |

**New schemes**

| | |
|---|---|
| Investigation on antifertility plants | Indian Council of Medical Research |
| Expansion of antifertility research programme | do |

**Schemes in progress**

| | |
|---|---|
| Physiology of reproduction | Ford Foundation |
| Development of potential anticancer agents | National Institute of Health, USA |
| Investigation of the distribution of Aerobic actinomycetes in India, with particular emphasis on their isolation, characterization, antibiotic production and preservation | P. L. 480 |
| Cholera enquiry | Indian Council of Medical Research |
| Study of genetics of *Vibrio cholerae* | World Health Organization |
| Study of sterility in laboratory animals | Indian Council of Medical Research |

**CRRI**

**Schemes completed**

| | |
|---|---|
| Investigations of roads in Bihar, Bengal, Orissa and Maharashtra under I. D. A. | Ministry of Transport |
| High embankments at junction of N. H. 2 and N. H. 6, I. D. A. Project | Ministry of Transport |

| *Laboratory and project* | *Sponsor* |
|---|---|
| Survey of soils and highway engineering materials for Rajasthan Canal Board for a length of 10 miles | Rajasthan Canal Board |
| Analysis and correction of landslides along the old Vasco Road in Marmugao | Marmugao Trust Port, Marmugao |

**New schemes**

| | |
|---|---|
| Survey of locally available materials including soils for the construction of about 1600 miles of border roads in states of Rajasthan and Gujarat | Ministry of Transport |
| Reclamation project and foundation treatment of ore handling yard at Goa port | do |
| Breakwater construction at Mangalore port | do |
| Analysis and recommendations concerning corrective measures for certain landslides | Directorate General of Border Roads |
| Assistance in reclamation project of the Marmugao Port Trust | Marmugao Port Trust, Goa |
| Foundations problems relating to the design of cargo jetty No. 6 at Kandla Port | Ministry of Transport |
| Survey of locally available materials including soils with a view to economizing on the construction cost for the construction of air fields at Barmer, Jaisalmer | Civil Aviation Authority |
| Quality control on the compaction of subgrade runway at Santa-cruz, Bombay | do |
| Design of internal roads for the Aero Engines Factory, Orissa | Government of Orissa |
| Traffic and transport estimation of Delhi | Metropolitan Transport Team of the Planning Commission |
| Construction of high embankment in Panjim | P. W. D., Goa |
| Investigation of cement concrete runway at Chabu in Assam | Army Headquarters, New Delhi |
| Investigation of pavements for inter-state bus terminus | C. P. W. D. |

**CECRI**

**Schemes in progress**

| | |
|---|---|
| Investigation into the corrosion of reinforcement in RCBW and RCCB construction | National Buildings Organization, New Delhi |
| Production of magnesium metal using Salem magnesite | Government of Madras |
| Improved methods of silver plating of copper wire (30 SWG) golden and colouring of imitation jari and gold plating of imitation and real jari | All India Handicrafts Board, Ministry of Commerce and Industry, New Delhi |

**CLRI**

**Schemes in progress**

| | |
|---|---|
| Factors responsible for yellow coloration of wool and means of eradicating the same | Indian Council of Agricultural Research |

| *Laboratory and project* | *Sponsor* |
|---|---|
| Shellac based leather finishes | Indian Lac Research Institute, Namkum |
| Fatliquors and syntans | National Research Development Corporation, New Delhi |

**CBRI**

**Scheme completed**

| | |
|---|---|
| Soil investigations for the bridge foundation over the river Bagmati, Kathmandu, Nepal | Indian Aid Mission, Nepal |

**Schemes in progress**

| | |
|---|---|
| Bricks from red soils of Hyderabad | Public Works Department, Hyderabad |
| Lime bursting in fired bricks | Brick and Tile Manufacturers Federation |
| Large panel prefabrication system | Planning Commission, New Delhi |

**NBG**

**Scheme in progress**

| | |
|---|---|
| Utilization of non-edible oilseed fats and constituents | Khadi & Village Industries Commission |

**New schemes**

| | |
|---|---|
| Studies on certain plant extracts and isolates having pesticidal properties | P. L. 480 |
| Animal food production having pesticidal properties | do |

**CSMCRI**

**Schemes completed**

| | |
|---|---|
| Recovery of borax from Pugga valley saline deposits | J & K Minerals Ltd, Kashmir |
| Washing of Kharaghoda salt | Hindustan Salts Ltd, Jaipur |

**New schemes**

| | |
|---|---|
| Decolorization of commercial magnesium | Pioneer Magnesia Works, Kharaghoda; Bharat Salt Works, Bhavnagar; and Umela Salt Works, Bhayandar |
| Desalination of seawater by H. D. technique | Government of Maharashtra, Bombay |
| Electrodialysis unit for desalination of brackish water | Atomic Energy Commission, Bombay |

**RRL Hyd.**

**Schemes in progress**

| *Laboratory and project* | *Sponsor* |
|---|---|
| Cottonseed oil | Indian Council of Agricultural Research & CSIR |
| Bleaching earths and activated carbons | do |
| Fatty acids | do |
| Surface coatings | do |
| Rancidity and antioxidants | do |
| Certification of standard bleaching earths | do |
| Cottonseed flour | ICAR |
| Occurrence of *Aspergillus flavus* | do |
| Standards for raw and washed cottonseed oil | do |
| Hydroxylated derivatives of safflower and linseed oils | P. L. 480 |
| Preparation of polymerizable monomers from castor oil hydroxy matured fatty acids | do |
| Active carbon Hykol 'X' | do |
| Development of know-how for the preparation of three important perfumery chemicals | Hindustan Lever Ltd |

**RRL Jammu**

**Scheme in progress**

| | |
|---|---|
| Standardization of the processing techniques of walnuts and developments of products from it | Hanraj and Sons, Jammu |

**CSIO**

**Scheme completed**

| | |
|---|---|
| Development of visual colorimeter | Oriental Science Apparatus Workshops, Ambala Cantt |

**Scheme in progress**

| | |
|---|---|
| Designing and fabrication of circular and rectangular moulds and their components | Terminal Ballistics Laboratory, Ministry of Defence |

**New schemes**

| | |
|---|---|
| Curve-generation box camera objective lenses | Vedsons, New Delhi |
| Pilot plant for the production of optical components | Laboratory Equipment Traders, Ambala |
| Fabrication of epidioscope mirrors and eyepieces | do |
| Fabrication of epidiascope mirrors and visual colorimeter optics | Oriental Science Apparatus Workshops, Ambala Cantonment |
| Development of process camera prisms | Monotype Corporation Ltd, Bangalore |
| Centering, edging and curve generation of lens blanks | Prince Optical Works, Delhi |

| *Laboratory and project* | *Sponsor* |
|---|---|
| **IIP** | |
| **Schemes completed** | |
| Selection of processing scheme for Madras refinery | Ministry of Petroleum and Chemicals |
| Benzene hydrogenation processes | |
| Commercial production of normal heptane | |
| Preliminary process and economical study on cyclohexane process | |
| Indigenous equipment and material for petroleum refineries, petrochemical plants and allied industries | |
| Production of aviation gasoline in India | |
| Evaluation of Darius crude | |
| Computer programme for HDS material balance | |
| Evaluation of activated clay | |
| Evaluation of Korvi clay from Barauni Refinery for I. O. C. | |
| Manufacture of aromatics and cyclohexane at Koyali refinery | |
| Processing of Koyali atmospheric residues visbreaking with hydrogenation of naphtha | |
| Preliminary valuation of Kathana crude | |
| **Schemes in progress** | |
| Gujarat petrochemical complex | Oil and Natural Gas Commission |
| Transformer oil | Sikri & Grover |
| Haldia Refinery Project | Ministry of Petroleum and Chemicals |
| Madras Refinery Project | do |
| Barauni Petrochemical Project | do |
| Lube Survey | do |
| Mineral turpentine oil survey and manufacture in India | do |
| Manufacture of reference fuels | do |
| North-West refinery | do |
| Aromatic chemicals from Iomex | do |
| Lube oil plant at Cochin/Bombay | do |
| Gujarat lube project | |
| Processing of atmospheric residium at Koyali | |
| Hydrogenation plant at Barauni refinery | |
| Pilot plant for separation of Burshane gas | |
| Lube oil reclamation plant for Calcutta | Jagodia Mercantile Calcutta |
| **New schemes** | |
| Preparation of cost of estimation file | |

| *Laboratory and project* | *Sponsor* |
|---|---|
| Aromatic chemicals from Iomex | |
| Pricing of Indian crude oils Lube Plant | Ministry of Petroleum & Chemicals |
| Iso-octane | |
| Utilization of Cambay natural gas condensate | |
| Manufacture of aviation gasoline | |
| Lubricating oils from Kalol-crude | |
| High softening point asphalt | |
| Pilot plant for separation of Burshane gas components | |
| Lube oil reclamation | |
| Hydrotreating pilot plant at Barauni | |
| Manufacture of deodorized iomex | |
| Indigenous equipment and materials for petroleum refineries, petrochemicals plants and allied industries | |
| Lubricating oil manufacture at Barauni Refinery | |

## Appendix 20

## NEW GRANTS-IN-AID TO RETIRED SCIENTISTS

| *Name* | *Subject of research* |
|---|---|
| Dr S. K. Guha<br>Patna University<br>Patna | Synthesis of thioindigoid, azines and azoles etc. (May 1, 1966) |
| Dr S. Aravamudan<br>Osmania University<br>Hyderabad | Determination of the proper motions of stars in the declination zones + 20 and + 30 (May 1, 1966) |
| Dr Swami Jnanananda<br>Andhra University<br>Waltair | Studies on the problem relating to nuclear structure employing magnetic spectrometer of the intermediate focussing type and conventional slow fast triple coincide spectrometers (May 1, 1966) |
| Dr Ram Kumar Goyal<br>S. M. S. Medical College<br>Jaipur | Study of a typical microbacteria (May 1, 1966) |
| Dr Kalipada Biswas<br>Calcutta University<br>Calcutta | Systematic botany including synecology with special reference to algae, flowering plants, etc. |
| Shri C. Ramaswami<br>Meteorological Office<br>Lodi Road, New Delhi | The Indian monsoon in relation to large scale patterns and weather development over the northern and southern hemispheres |

## Appendix 21

## ACQUISITION OF LAND

| *Laboratory* | *Area, Location and Purpose* |
|---|---|
| CFTRI | 150 acres of land adjoining Cheluvamba Mansion acquired from the Government of Mysore |
| ITRC | 42, 183 sq. ft of land, acquired by CDRI from the Government of U.P., transferred to ITRC |
| CMERI | 40 acres of land at Ludhiana, donated by the Government of Punjab, for the construction of MERDO Ludhiana Centre; 20 acres of land allotted by Government of Madras for the construction of MERDO Madras Centre |
| | **Progress of Building Construction** |
| NCL | Extensions of gelatine shed and office building on the second floor completed. Pilot plant shed for organic intermediate dyes division completed |
| CFTRI | Construction of additional building on the first floor completed. Extension of machine shop to house engineering stores completed |
| CGCRI | Extensions of Optical Glass Block and Optical Glass Furnace Room completed. |
| CDRI | Construction of New Laboratory Block and the overhead water tower completed |
| CECRI | Construction of building for Sodium plant completed |
| RRL Hyd. | Construction of pilot plant and a shed for A. C. C. rotary kiln completed |
| NAL | Construction of first floor for the main laboratory and technology blocks completed |
| NGRI | Construction of Earth Current Observatory and Workshop Shed completed |

## Appendix 22

## DEPUTATIONS

### Director-General

Dr S. Husain Zaheer

New York — To attend the Symposium on Science in South Asia

Washington — For discussion with the President, National Academy of Sciences, regarding finalization of exchange programme and negotiation with the US organization for an outright gift of a research ship and financial assistance

Cambridge — Visit to Harvard University; Ottawa : For discussion with the President, National Council regarding finalization of scientific exchange programme between NRC and CSIR

London — For discussions with the Secretary, Ministry of Overseas Development and Director-General, British Council regarding exchange of scientists

Paris — For discussions with the Chief of CNRS, French Govt Officials and IFP Officials regarding bilateral exchange programme assistance of equipment for CSIR and extension of agreement; and, Bonn — For discussion with the Secretary-General, German Academic Exchange Service, General-Secretary, German Academy of Sciences and GDR Officials regarding exchange programme and procurement of scientific equipment for CSIR (May 3-31, 1966)

Dr Atma Ram

UK — Meeting of the British Association for the Advancement of Science. Visit to laboratories and institutes for discussing problems of mutual interest with eminent scientists (Aug. 28 to Sept. 15, 1966)

### Directors and Scientists-in-Charge

Dr B. D. Tilak, NCL

Brussels — Thirty-sixth International Conference on Industrial Chemistry (Sept. 10-21, 1966)

UK — To visit chemical industries and research laboratories

Switzerland — To visit chemical industries and research laboratories

Germany — To visit chemical industries and research laboratories

UAR — To visit chemical industries and research laboratories

Dr A. R. Verma, NPL

Moscow — Seventh International Congress on Crystallography and Symposium on Crystal Growth (July 12-21, 1966)

USA — International Conference on Crystal Growth at Boston (June 20-24, 1966)

Dr H. A. B. Parpia, CFTRI

West Germany — Seventh International Congress of Nutrition (Aug. 3-10, 1966)

Geneva — Meeting of the protein Advisory Group (Aug. 17-19, 1966)

Hamburg, Geneva, Warsaw & Rome — Poultry Advisory meeting of WHO/FAO, UNICEF Executive Committee meeting

Poland — Second International Congress of Food Science and Technology (Aug. 22-27, 1966)

[illegible] Committee of the International Food Technology Train-

Dr B. R. Nijhawan, NML

New York — Inter-regional Seminar on Ore Concentration in Water-short Areas, at the invitation of U.N. Bureau of Technical Assistance Operations on Hand-sorting and Mechanical Packing (Feb. 14-25, 1966)

Dr M. M. Dhar, CDRI

Sweden — Fourth International Symposium on Chemistry of Natural Products, Stockholm (June 23 to July 15, 1966)

Prof. S. R. Mehra, CRRI

West Germany — Visit to scientific and research institutions at the invitation of German Academic Exchange Service (3 weeks ending October 16, 1966)

Dr Y. Nayudamma, CLRI

New York — Inventory Conference on Science and Society in South Asia as also Conference on Science and Technology in South Asian Countries organized by the Rockfeller University in May 1966; Visit to factories and Eastern Regional Research Laboratory, Philadelphia

Hungary, Germany & Yugoslavia — International Leather Chemists' Conference at Budapest (Oct. 2, 1966); Visit to research institutions in Germany, Yugoslavia and Hungary

Dr Amarjit Singh, CEERI

UK, West Germany & Hungary — Conference on Microwave and Optical Generation and Amplifications under the Exchange Agreement with British Council (UK); URSI General Assembly in Munich; Visit to research institutes and factories in Hungary

Dr M. S. Iyengar, RRL Jorhat

Poland, London & Paris — Visit commencing on Sept. 24, 1966 to various Polish research institutions and industries under the Protocol for Scientific Cooperation with Foreign Countries by the Council of Ministers of the People's Republic of Poland and Exchange Programme for Scientific Cooperation between CSIR and Polish Academy of Sciences; visit to scientific institutions in London and the French Institute of Petroleum, Paris

Shri R. S. Mehta, CPHERI

Munich — Third International Conference on Water Pollution Research (Sept. 5-9, 1966)

Teheran, Iran — Inter-regional Symposium on Developmental Work in Country Water Supply held in Teheran, Iran (Oct, 24 to Nov. 3, 1966)

Shri R. M. Chakravarthi, BITM

New Delhi — Unesco's Regional Seminar on Museums, as observer (Jan. 1966)

Shri A. Bose, Curator-in-Charge, VITM

Tokyo — Eleventh Pacific Science Congress (Aug. 30 to Sept. 7, 1966)

Shri S. Ramamurthy, Curator, VITM

New Delhi — Unesco's Regional Seminar on Museums, as observer (Jan. 1966)

Dr N. K. Panikkar, NIO

Moscow — Second International Oceanographic Congress (June 1-10, 1966)

Prof. G. S. Ramaswamy, SERC

UK — To participate in the International Symposium on the use of Electronic Digital Computers in Structural Engineering (July 4-8, 1966); to visit the University of Southampton and Building Research Station, Garston under the programme for scientific exchange between CSIR and the British Council

Shri A. Rahman, RSPO

London — Science of Science Foundation (March, 1966)

USA — Invitation by Rockfeller Foundation (May, 1966)

Czechoslovakia — Coordinators' Meeting on Science Policy (under the auspices of Unesco) at Karlovy Vary (June 1966)

Dr K. S. Chari, CDEO

UK — International Chemical & Petroleum Engineering Exhibition at Olympia and European Federation of Chemical Engineering and visit to design and engineering organizations (June 13 to July 2, 1966)

**Scientists**

**NCL**

Dr Sukh Dev

Sweden — International Symposium on Natural Products (June 20 to July 2, 1966)

**NPL**

Dr A. K. Saha

USSR — Member of the Indian delegation to Ninth Plenary Assembly and Seventh International Space Symposium sponsored by INCOSPAR under the Indo-Soviet Cultural Exchange Programme (April 29 to May 29, 1966)

Dr A. P. Mitra

USSR — Member of the Indian delegation to Ninth Plenary Assembly and Seventh International Space Symposium (May 10-19, 1966)

East Germany — Visit to Ionospheric and Radiochemical Institution (May 20 to June 2, 1966)

USA — Visit to Pennsylvania University

Dr S. C. Jain

USA — International Conference on Crystal Growth, Boston (June 20-24, 1966)

Hungary — Conference on Luminescence in Budapest (Aug. 23-30, 1966)

**CFTRI**

Dr H. S. Desikachar

Japan — Symposium on problems in development and ripening of rice grain and visit to rice milling and rice bran factories in Japan under the auspices of Science Council of Japan (Aug. 19 to Sept. 4, 1966)

Dr P. R. Krishnaswamy

Berlin — International Seminar on Nutrition problems at the invitation of the Federal Republic of Germany (March 10 to April 6, 1966)

Dr N. L. Lahiry

Burma, Thailand, Philippines, Hong Kong & Japan — To study the problems in the meat, poultry and fish technology under FAO programme (July 13 to Aug. 13, 1966)

Dr B. Panda

Russia — Twelfth World's Congress; Visit to different livestock and poultry centres in the Soviet Union under Indo-Soviet Cultural Exchange Agreement

**CDRI**

Dr K. Bhaskaran

Geneva — As Medical Consultant under World Health Organization (2 months)

Dr M. M. Dhar

**CBRI**

Shri K. L. Dutta

Netherlands — To study housing, planning and reconstitution programme at the invitation of Govt of Netherlands (5 weeks)

**NBG**

Dr L. D. Kapoor

Nepal — To advise the Department of Medicinal Plants on development and utilization of medicinal plantation at the request of HM's Govt of Nepal (Dec. 5-25, 1966)

Dr P. K. K. Nair

Netherlands — Second International Conference in Polynology at Utrecht (Aug. 29 to Sept. 3, 1966)

**RRL Hyd.**

Dr P. M. Bhargava

Italy, France & UK — Fourth meeting on Control Processes and Molecular Biology of the International Cell Research Organization in Naples (May 1966); to deliver special lectures in Marsalles, Paris, London, Glasgow, Edinburgh and Cambridge

**IIEM**

Dr S. Mukerjee

Japan & USSR — Eleventh Pacific Science Congress (Aug. 22-24, 1966); Visit to laboratories engaged in live vaccine work in Moscow, Leningrad Rostov-on-Don and Saratov under the Indo-USSR Cultural Exchange Plan (3 weeks)

**CPHERI**

Dr J. S. S. Lakshminarayana

Munich — Third International Conference on Water Pollution Research (Sept. 5-9, 1966)

Dr G. J. Mohanrao

Munich — Third International Conference on Water Pollution Research (Sept. 5-9, 1966)

**CIMPO**

Shri B. C. Gulati

Bulgaria — To acquaint with the latest techniques in the field of cultivation of medicinal plants (8 weeks)

**NAL**

Shri A. Krishnan

Canada — In connection with the design, manufacture and supply of the Data Acquisition System for the 4 ft × 4 ft Trisonic Wind Tunnel

Shri S. Nagabhushana

Canada — In connection with the design, manufacture and supply of the Data Acquisition system for the 4 ft × 4 ft Trisonic Wind Tunnel

**NIO**

**RSPO**

Shri P. N. Chowdhury

Berlin — Scientific Exchange Programme between CSIR & Academy of Sciences, Berlin, GDR (July 4 to Aug. 18, 1966)

Shri K. C. Sen Gupta

USSR — Indo-Soviet Cultural Exchange Agreement (April 8 to July 9, 1966)

**Scientists other than CSIR**

Prof. T. R. Seshadri (Emeritus Professor, Delhi University, Delhi), Chairman, Chemical Research Committee, CSIR

UK — Meeting of the British Association for the Advancement of Science; Visit to laboratories and institutes (Aug. 31 to Sept. 7, 1966)

FELLOWSHIPS AND OTHER TECHNICAL AID PROGRAMMES

| *Laboratory* | *Name* | *Subject & Duration* | *Country* |
|---|---|---|---|
| | | **Colombo Plan** | |
| NCL | Dr A. B. Deshapande | Training in Studies in Polymers (one year) | Japan |
| NPL | Dr V. N. Bindal | Training in Techniques of Standardization, Calibration and Measurements in various branches of acoustics (one year) | UK |
| NML | Shri B. K. Guha | Training in the field of alloy and special steel metallurgy (6 months) | Canada |
| | Shri B. N. Halder | Training in the field of application of electron microscope and electron micro-probe analyser to study ferrous and non-ferrous metals and the development of alloys (8 months) | UK |
| CDRI | Dr O. P. Babbar | | UK |
| CECRI | Shri S. Viswanathan | Fused Salt Electrolysis (1 year) | UK |
| CBRI | Shri S. S. Rehli | Cement and cement products using low grade naturally occurring materials and industrial waste (12 months) | UK |
| CSMCRI | Shri P. S. Rao | Cultivation of marine algae (one year) | Japan |
| CMRS | Shri D. P. Dutta | Hydraulic Striving of Metal Mines and ESR & NMR techniques (6 months) | Australia |
| RRL Hyd. | Shri R. Subba Rao | | UK |
| CPHERI | Shri W. M. Dishpande | Waste Water Treatment (6 months) | UK |
| | Shri P. K. Yennawar | Methodology of Air Pollution Study (1 year) | Canada |

| *Laboratory* | *Name* | *Subject & Duration* | *Country* |
|---|---|---|---|
| | | **U.N. Special Fund Aid Programme** | |
| CSIO | Shri M. L. Gupta | Thermal Instruments | UK |
| NAL | Shri K. Sridhara | Training in Propulsion (14 months) | UK |
| | Shri K. V. Krishna Rao | Training in Aeroelasticity (10 months) | USA |
| | Shri L. S. Manavalan | Instrumentation (9 months) | UK |
| | | **Unicef** | |
| CFTRI | Shri C. T. Dwarkanath | Peanut flour detoxication combined with aflatoxin testing (one year) | USA |
| | | **Unesco** | |
| CDRI | Shri A. C. Shipstone | Modern problems in biology, Praha | Czechoslovakia |
| | Shri M. R. Katty | Modern problems in biology, Praha | Czechoslovakia |
| NAL | K. D. Pavate | Electronics (10 months) | Czechoslovakia |
| | M. L. Kaul | Electronics in digital circuitry (9 months) | France |
| | | **Programme of International Seminar in Chemical Engineering and Physical Chemistry** | |
| NML | Dr P. Prabhakaran | Training in the field of radio active isotopes and their application to problems concerning chemical metallurgy (14½ months) | West Germany |
| | | **Programme of Exchange of Visits of Young Scientists between India and UK** | |
| NAL | Shri S. A. Hassainy | Training in thermo-elasticity at the School of Engineering, Bristol College of Science and Technology (3 months) | UK |
| | | **Federal Republic of Germany Scholarship** | |
| CFTRI | Shri S. R. Sharpalekar | Advanced study and research (16 months) | West Germany |
| CDRI | Dr R. T. Talwalkar | Advanced study | West Germany |
| CBRI | Shri S. Venkatesan | Advanced study and research in soil pressure on actual structure and instrumentation (16 months) | West Germany |
| CECRI | Shri K. S. Udupa | Kinetics and Mechanism of electro organic reactions (16 months) | West Germany |
| | | **German Academic Exchange Service** | |
| RRL Jorhat | Shri D. P. Sastry | | West Germany |
| CMERI | Shri B. Kanakayya | Automobile Engineering (18 months) | West Germany |

| *Laboratory* | *Name* | *Subject & Duration* | *Country* |
|---|---|---|---|
| NAL | Shri A. Krishnan | Advanced Studies and Research (16 months) | West Germany |
| | Shri K. S. Hebbar | Advanced Studies and Research (16 months) | West Germany |
| | **Indo-French Technical Cooperation Agreement** | | |
| NCL | Shri A. D. Deshpande | Fluidization and its application to chemical engineering operations and processes | France |
| NML | Shri S. R. Srinivasan | Recent trends in extraction metallurgy techniques | do |
| | Shri J. E. Mannar | Operational research in iron and steel making processes (3 months) | do |
| CECRI | Shri M. Sundaram | Protection against corrosion (7 months) | do |
| | **Indo-Polish Cultural Exchange Programme** | | |
| NML | Shri J. Goswami | Latest developments in iron blast furnace technology (6 months) | Poland |
| RRL Hyd. | Shri K. Hanumanlu | | do |
| CMRS | Shri V. S. Narayana | Mine Ventilation (5 months) | Poland |
| | **Indo-Soviet Cultural Exchange Programme** | | |
| RRL Hyd. | Shri Bharat Bhushan | Member, Indian Delegation to Hungary | USSR |
| IIEM | Dr S. Mukherjee | To visit the laboratories engaged in live vaccine work (3 weeks) | do |
| | **National Academy of Sciences** | | |
| NPL | Dr Y. V. Somayagulu | Advanced training and research in space science (one year) | USA |
| | **National Research Council, Canada** | | |
| RRL Hyd. | Dr N. S. Rajagopal | | Canada |
| | **USSR Government Scholarships** | | |
| NBG | Shri P. N. Saxena | Studies in Algology at the Lenin State University, Tashkent and at the Komarov Institute of Botany, Leningrad (3 years and 4 months) | USSR |
| RRL Hyd. | Shri M. Narayana Reddy | | USSR |
| | **Miscellaneous Fellowships** | | |
| NCL | Shri P. S. Kulkarni | Training in mass spectrometry at | Australia |
| CDRI | Dr M. C. Khosla | Fellowship offered by Cleveland Foundation, Ohio | USA |
| CRRI | Shri K. R. Rao | Study leave (2 years) | Australia |
| NBG | Shri N. C. Pathak | Belgian Govt Scholarship for higher training in mushroom cultivation | Belgium |
| RRL Hyd. | Dr M. W. Roomi | Alexander von Hamboldt scholarship | West Germany |
| | Dr P. B. Sattur | Post-doctoral appointment, University of California | USA |
| CPHERI | Shri R. S. Kshisagar | International course in Sanitary Engineering (10 months) | Neatherlands |
| CMERI | Shri G. V. Ramaniah | Thermal Engineering under Hungarian Govt Scholarship (18 months) | Hungary |
| | Shri V. M. Menon | Industrial Engineering under exchange programme between CMERI & Union College, Schenectady, New York (9 months) | USA |
| | Shri S. N. Bhagi | Mechanical Engineering under exchange programme between CMERI & Union College, Schenectady, New York (9 months) | USA |
| NAL | Sarvashri A. Krishnan & S. Naga Bhushana | Design, manufacture and supply of the data acquisition system under 4 ft tunnel project (14 weeks) M/s Philips Ltd, Toronto | Canada |

## Appendix 23

## SPECIAL TRAINING COURSES

| *Laboratory* | *Training Course* |
|---|---|
| CFTRI | M.Sc. in Food Technology (2 years) |
| | Short-term courses in Durofume and related pest control processes; Infestation control in raw and processed foods; problems of rural storage; Fruit and vegetable technology; Fruit and vegetable preservation and meat and fish technology to trainees and students |
| | Training to Agriculture and Extension officers in Mysore State on Disinfestation Techniques with special reference to rural areas |
| CFRI | Advanced course in Fuel Technology (one year from Aug. 1966) to research workers of the Institute |
| | Training in operation and maintenance of High Temperature Carbonization pilot plant and Coke Testing Practice (one year) for graduate apprentices of the Institute and (nine months) for senior and junior stipendiaries of the Government of India |
| | Training in Low/Medium Temperature Carbonization prototype and associated plants for trade apprentices and vocational trainees (three years) |
| | Training in Tar and Byproduct Utilization to fourth year students from Bihar Institute of Technology, Sindri |
| | Laboratory and pilot plant training in coal washing, training in plant operation and instrumentation, theoretical and practical training in coal preparation to M.Sc. (Ore Dressing) students |
| | Special training on reflectance measurements in Coal Petrology for a Research Fellow from the Indian School of Mines, Dhanbad |
| CGCRI | Short-term specialized training in glass, refractories, enamels, whitewares and chemical analysis to trainees from industry and Ministry of Education |
| CRRI | Refresher courses for senior and junior highway engineers |
| | Training course (six weeks) for staff members of Border Roads Organization |
| CECRI | Storage Battery Technology (June 6 to July 29, 1966) |
| | Corrosion and its prevention (Aug. 1 to Sep. 3, 1966) |
| | Electroplating (Sept. 6 to Nov. 30, 1966) |
| CLRI | Short-term course on leather manufacture for artisans from rural industries |
| | Project, Andhra Pradesh and twenty stipendiaries of the Government of India |
| | Refresher courses for extension staff of the Institute on latest developments in tanning techniques |
| CBRI | Advance course on Building Physics (two weeks) for architects and engineers (Jan. to Feb. 1966) |
| | Refresher course on Building Foundation Engineering, Concrete Technology and Structures in collaboration with Roorkee University (Nov. 16 to Dec. 15, 1966) |
| CEERI | Summer school in Electronic Control in collaboration with Ministry of Education and U S Agency for International Development (Jan. 13 to July 21, 1966) |
| CSMCRI | Training courses on quality control of salt to (i) graduates and (ii) matriculates with experience in salt manufacture (Feb. 7-19, 1966) |

| *Laboratory* | *Training Course* |
|---|---|
| RRL Hyd. | Training of plant operators from Synthetic Drugs Project, Hyderabad. In-plant training of students of chemical engineering from Indian Institute of Technology, Madras |
| BITM | Practical training in diorama making, display, lighting, tools and machines, show case designs, labelling classification of exhibits in a science museum, organization of exhibition and film shows to ten students of Museology, Calcutta University |
| | Creative Ability Centre for school students started from Nov. 1966 |
| CMERI | Regular courses in Fortran programming for scientists of the Institute as well as outsiders |
| | Training in metrology, non-destructive testing, I.C. engines, vibration and noise control, automobile, drawing and design, hydrodynamic machinery, electronics and instrumentation and power engineering |
| CSIO | Instrument Technology course (three years); Training course in testing and use of optical instruments to candidates from agricultural colleges and universities (Feb. 7-26, 1966);Training Course in Optical Glass Working (nine months) for trainees from industry (Feb. 9 to Nov. 1, 1966) |
| | Practical training in electronic instrumentation (six weeks) for students from Punjab Engineering College and (four weeks) for a candidate from M.I.T. |
| IIP | Third session of training course from Aug. 1966 (15 months) in Petroleum Refining, Petrochemicals and Utilization of Petroleum products in engines and industries for a batch of post-graduate trainees |
| | Short-term practical training courses in utilization of fuels and lubrication in diesel engines for railway officers (April 4 to Sept. 27, 1966) |
| NAL | Three short-term courses on computer programme in Sirius auto-code |
| NIO | Training programme in oceanography (six weeks) at Bombay in collaboration with Unesco (Jan. to March 1966) |
| SERC | Special training courses in digital computation and numerical methods to officers of laboratories, universities, government departments and the army |
| Corrosion Advisory Bureau, MRC | Lecture-cum-demonstration course on Corrosion and its prevention (Nov. 22-25, 1966) |

## Appendix 24

### INTERNATIONAL AID

| *Laboratory* | *Aid* |
|---|---|
| CFTRI | Grant : For one scheme Rs 1,277,176 under P.L. 480 |
| CDRI | Grant : (i) From Ford Foundation Rs 58,490; (ii) from N.I.H. Scheme Rs 2,000; (iii) from Riker Laboratories, USA Rs 7,280; and (iv) from WHO Rs 1,538 |
| CLRI | Grant : For two research schemes Rs 518,698 under P.L. 480, US Department of Agriculture |
| | Equipment : One U. V. lamp, 12 quartz containers and 1 recorder for small electrical currents |
| | Experts : One expert from Manchester University, UK under Colombo Plan and one UN Tannery Expert from Yugoslavia under UNTA Programme |
| CMRS | Equipment : Worth £2302 under Colombo Plan |
| RRL Hyd. | Grant : For two research schemes Rs 126,838 under P.L. 480, US Department of Agriculture |
| | Equipment : Worth Rs 80,000 received from UNICEF |
| CPHERI | Equipment : Worth $1,01,508 received under UN Special Fund Assistance |
| CMERI | Equipment : Worth $25,000 received under UN Special Fund Assistance |
| | Expert : One expert joined the Institute as Chief Technical Expert, under UN Special Fund Assistance |
| IIP | Grant : Received $1,169,850 from UN Special Fund Assistance |

## Appendix 25

### DISTRIBUTION OF RESEARCH SCHEMES AND FELLOWSHIPS OTHER THAN IN NATIONAL LABORATORIES

| University/Institution | Research Schemes | Fellows/ Assistants in Schemes | Ad hoc Fellowships | | Total Fellowships |
|---|---|---|---|---|---|
| | | | SRF | JRF | |
| (1) | (2) | (3) | (4) | (5) | (6) |
| **Agra University** | 1 | 1 | — | — | 1 |
| Agra College, Agra | 1 | 1 | — | 3 | 4 |
| D. A. V. College, Dehra Dun | — | — | — | 1 | 1 |
| D. A. V. College, Kanpur | — | — | 1 | — | 1 |
| D. A. V. College, Muzaffarnagar | 1 | 1 | — | — | 1 |
| D. N. College, Meerut | — | — | — | 1 | 1 |
| D.S.B. Government College, Nainital | 1 | 2 | 2 | 3 | 7 |
| Government Agriculture College, Kanpur | — | — | 1 | 13 | 14 |
| G.S.V.M. Medical College, Kanpur | — | — | 8 | — | 8 |
| Institute of Social Sciences, Agra | — | — | — | 1 | 1 |
| Meerut College, Meerut | 1 | 1 | — | 2 | 3 |
| St John's College, Agra | — | — | — | 1 | 1 |
| U.P. College of Veterinary Science & Animal Husbandry, Mathura | — | — | 1 | 3 | 4 |
| **Aligarh Muslim University** | 20 | 30 | 4 | 28 | 62 |
| **Allahabad University** | 35 | 36 | 33 | 41 | 110 |
| C.M.P. Degree College, Allahabad | 1 | 1 | — | — | 1 |
| M.N.E. Engg College, Allahabad | — | — | 1 | — | 1 |
| **Andhra University** | 33 | 41 | 13 | 58 | 112 |
| College of Engg, Kakinada | 1 | 1 | — | — | 1 |
| **Annamalai University** | 2 | 1 | 1 | 15 | 17 |
| **Banaras Hindu University** | 33 | 41 | 11 | 41 | 89 |
| **Bihar University** | 1 | 2 | — | — | 2 |
| Bihar Agricultural College, Sabour | — | — | — | 1 | 1 |
| Bihar Veterinary College, Patna | — | — | 1 | 4 | 5 |
| **Bombay University** | 8 | 8 | 1 | 2 | 19 |
| Seth G.S. Medical College, Bombay | 3 | 17 | — | — | 1 |
| St Xavier's College, Bombay | 3 | 8 | — | — | 1 |
| Wilson College, Bombay | 1 | 1 | — | 1 | 2 |

APPENDIX 25—*Contd*

| (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| **Calcutta University** | 45 | 68 | 10 | 15 | 93 |
| Bengal Engineering College, Howrah | 3 | 5 | — | 3 | 8 |
| Medical College, Calcutta | 1 | 1 | — | — | 1 |
| Presidency College, Calcutta | 17 | 23 | 2 | 7 | 32 |
| **Delhi University** | 25 | 42 | 16 | 60 | 118 |
| Lady Hardinge Medical College & Hospital, New Delhi | 1 | 3 | — | — | 3 |
| Maulana Azad Medical College, New Delhi | — | — | 2 | — | 2 |
| **Gauhati University** | 2 | 2 | — | 2 | 4 |
| Assam Veterinary College, Gauhati | — | — | 1 | — | 1 |
| **Gorakhpur University** | 17 | 25 | — | 19 | 44 |
| **Gujarat University** | 4 | 5 | — | 3 | 8 |
| Ahmednagar College, Ahmednagar | 1 | 2 | — | 3 | 5 |
| **Indian Agricultural Research Institute** | — | — | 21 | 95 | 116 |
| **Indian Institute of Science, Bangalore** | 16 | 30 | 27 | 12 | 69 |
| **Jabalpur University** | 1 | 1 | 1 | 8 | 10 |
| Government Engineering College, Jabalpur | 2 | — | — | 3 | 3 |
| Government Science College, Jabalpur | — | — | — | 3 | 3 |
| **Jadavpur University** | 26 | 35 | 7 | 13 | 55 |
| **Jammu & Kashmir University** | 3 | 3 | — | 4 | 7 |
| **Jodhpur University** | 20 | 10 | — | 5 | 15 |
| **Kalyani University** | 9 | 10 | — | 9 | 19 |
| **Karnatak University** | 5 | 5 | 2 | 17 | 19 |
| **Kerala University** | 4 | 6 | — | 10 | 16 |
| N.S.S. College of Engineering, Palghat | 1 | — | — | — | — |
| College of Engg, Trivandrum | 1 | 1 | — | — | — |
| **Kurukshetra University** | — | — | — | 5 | 5 |
| K.N. Degree College, Kurukshetra | — | — | — | 1 | 1 |
| **Lucknow University** | 28 | 31 | 3 | 26 | 60 |
| K.G. Medical College, Lucknow | 3 | 7 | 1 | — | 8 |
| **Madras University** | — | — | 5 | 7 | 12 |
| A.C. College of Technology, Madras | 9 | 16 | — | — | 16 |
| Christian Medical College, Vellore | 3 | 7 | 2 | 1 | 10 |
| Coimbatore Institute of Technology, | 1 | 1 | — | 1 | 2 |
| Madras Christian College, Madras | 1 | — | — | 2 | 2 |
| Madras Veterinary College, Madras | — | — | 1 | — | 1 |
| Pachaiyappa College, Madras | 1 | 1 | 1 | — | 3 |
| Presidency College, Madras | — | — | 2 | 2 | 4 |
| P.S.G. College of Technology, Coimbatore | 11 | 9 | — | — | 9 |
| St Joseph's College, Tiruchirapalli | 1 | 1 | — | 2 | 3 |
| Vivekananda College, Madras | 1 | 1 | — | — | 1 |
| **Madurai University** | 1 | 1 | — | — | 1 |
| Thiagarajar College of Engineering, Madurai | 1 | — | — | — | — |
| **M.S. University of Baroda** | 9 | 10 | 1 | 7 | 18 |
| **Marathwada University** | 5 | 6 | — | 1 | 7 |
| **Mysore University** | 5 | 5 | 1 | 8 | 14 |
| Central College, Bangalore | 3 | 3 | — | 7 | 10 |
| Kasturba Medical College, Mangalore | — | — | 1 | — | 1 |
| **Nagpur University** | 3 | 6 | — | 8 | 14 |
| Laxminarayan Institute of Technology, Nagpur | 2 | 2 | — | 1 | 3 |
| Nagpur Veterinary College, Nagpur | — | — | — | 3 | 3 |
| **North Bengal University** | 3 | 2 | — | — | 2 |
| **Osmania University** | 2 | 2 | 7 | 33 | 42 |
| **Panjab University** | 16 | 28 | 5 | 30 | 63 |
| Punjab Engineering College, Chandigarh | 1 | 1 | — | 1 | 2 |
| **Patna University** | — | — | 3 | 4 | 7 |
| **Poona University** | 2 | 2 | 1 | 7 | 2 |
| College of Agriculuture, Poona | — | — | — | 1 | 1 |
| **Punjabi University** | 1 | 1 | 1 | 2 | 4 |
| **Punjab Agricultural University** | — | — | 1 | 15 | 16 |
| **Rajasthan University** | 22 | 28 | 6 | 11 | 45 |
| Birla Science College, Pilani | 1 | 1 | — | 1 | 2 |
| Birla Institute of Technology & Science, Pilani | 4 | 5 | — | 2 | 7 |
| Birla College of Engineering, Pilani | — | — | 1 | 2 | 3 |
| Government College, Ajmer | — | — | — | 1 | 1 |
| Government College, Kotah | — | — | — | 1 | 1 |

APPENDIX 25—*Contd*

| (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| **Roorkee University** | 13 | 10 | 8 | 28 | 46 |
| **Sagar University** | 2 | 2 | 1 | 17 | 20 |
| **Sri Venkateswara University** | 7 | 8 | 5 | 7 | 20 |
| **Udaipur University** | 2 | 2 | — | 5 | 9 |
| **U.P. Agriculture University** | — | — | 3 | 1 | 4 |
| **Utkal University** | 1 | 1 | — | 5 | 6 |
| **Vikram University** | 5 | 6 | — | 11 | 17 |
| College of Agricultural Research, Gwalior | — | — | — | 1 | 1 |
| G.R. Medical College, Gwalior | — | — | 1 | — | 1 |
| **Visva Bharati University** | 1 | 1 | — | — | 1 |
| **Other Institutions** | | | | | |
| Agricultural Research Institute, Coimbatore | — | — | 1 | 1 | 2 |
| Agricultural Research Institute, Trivandrum | — | — | — | 1 | 1 |
| All India Institute of Medical Sciences, New Delhi | 2 | 10 | 9 | 5 | 24 |
| All India Radio, New Delhi | 1 | 22 | — | — | 22 |
| Balwant Rajput College, Agra | 1 | 1 | — | 1 | 2 |
| B.C.J. Science College, Camby | 2 | 2 | — | — | 2 |
| Bengal Immunity Research Institute, Calcutta | 5 | 11 | 1 | — | 12 |
| Bhavan's College, Bombay | 1 | 1 | — | — | 1 |
| B.J. Medical College, Poona | — | — | 1 | — | 1 |
| Bombay Natural History Society, Bombay | — | — | 1 | — | 1 |
| Bose Institute, Calcutta | 13 | 19 | 1 | 2 | 4 |
| B.S. Agarwal College, Mathura | 1 | — | — | — | — |
| Central Arid Zone Research Institute, Jodhpur | — | — | — | 2 | 2 |
| Central Rice Research Institute, Cuttack | — | — | 1 | 1 | 2 |
| Central Tuberculosis Research Station, Trivandrum | — | — | 1 | — | 1 |
| Chittaranjan National Cancer Research Institute, Calcutta | — | — | — | 1 | 1 |
| Cinchona Department, Ootacamund | 1 | — | — | — | — |
| College of Science, Raipur | — | — | 1 | — | 1 |
| College of Veterinary & Animal | — | — | 4 | — | 4 |

| (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| Darbhanga Medical College, Darbhanga | — | — | 5 | — | 5 |
| Department of Fisheries, Bombay | — | — | — | 1 | 1 |
| Documentation Research & Training Centre, Bangalore | — | — | — | 1 | 1 |
| Durgapur Steel Plant, Durgapur | 2 | 2 | — | — | 2 |
| Forest Research Institute & Colleges, Dehra Dun | — | — | 1 | — | 1 |
| Government Medical College, Patiala | — | — | 1 | — | 1 |
| Government College of Engineering & Technology, Raipur | 1 | 1 | — | 1 | 2 |
| Government Science College, Raipur | 1 | 1 | — | — | 1 |
| G.S. Technological Institute, Indore | — | — | — | 1 | 1 |
| Haffkine Institute, Bombay | 2 | 2 | — | — | 2 |
| H.B.T. Institute, Kanpur | 1 | 1 | 3 | — | 4 |
| Heavy Engineering Corporation Ltd, Ranchi | 1 | 1 | — | — | 1 |
| Hides Improvement Society, Madras | 1 | 1 | — | — | 1 |
| Hindu College, Moradabad | — | — | — | 1 | 1 |
| Holka Science College, Indore | — | — | 1 | — | 1 |
| Hospital for Mental Diseases, Ranchi | — | — | 1 | 1 | 2 |
| Hyderabad Science Society, Hyderabad | 2 | 2 | — | — | 2 |
| Indian Association for the Cultivation of Science, Calcutta | 14 | 25 | 3 | 4 | 32 |
| Indian Institute of Technology, Bombay | 3 | 3 | 2 | 5 | 10 |
| Indian Institute of Technology, Kanpur | 19 | 29 | 5 | 23 | 57 |
| Indian Institute of Technology, Kharagpur | 16 | 22 | 8 | 18 | 48 |
| Indian Institute of Technology, Madras | 15 | 25 | — | 13 | 38 |
| Indian Institute of Technology, New Delhi | 7 | 25 | — | 9 | 34 |
| Indian Jute Mills Association Research Institute, Calcutta | 1 | 1 | — | — | 1 |
| Indian School of Mines, Dhanbad | — | — | — | 2 | 2 |
| Indian Veterinary Research Institute, Mukteswar | — | — | 5 | 10 | 15 |
| Institute of Agriculture, Anand | — | — | — | 1 | 1 |
| Institute of Child Health, Calcutta | 1 | 1 | — | — | 1 |
| Institute of History of Medicine & Medical Research, New Delhi | 2 | 2 | — | — | 2 |

APPENDIX 25—*Contd*

| (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| Institute of Post-graduate Medical Education & Research, Calcutta | — | — | 3 | — | 3 |
| Institute of Science, Bombay | 7 | 12 | 2 | 5 | 19 |
| Irrigation Research Station, Madras | 1 | 1 | — | — | 1 |
| Jawaharlal Nehru Krishi Vishwa Vidyalay, Jabalpur | — | — | — | 2 | 2 |
| K.N. Government College, Gyanpur | 1 | 1 | — | — | 1 |
| Lakshminarayan Institute of Technology, Nagpur | 2 | 2 | — | 1 | 3 |
| Livestock Research Station, Patna | — | — | 1 | 1 | 2 |
| M.A. College of Technology, Bhopal | 1 | 2 | — | — | 2 |
| Madhav Engineering College, Gwalior | — | 1 | — | — | 1 |
| Madras Institute of Technology, Madras | 2 | 2 | — | 2 | 4 |
| Malviya Engineering College, Jaipur | 1 | 1 | — | — | 1 |
| Maharashtra Association for the Cultivation of Science, Poona | — | — | 1 | 4 | 5 |
| Maulana Azad College of Technology, Bhopal | — | — | — | 1 | 1 |
| Medical College, Baroda | 1 | 5 | — | — | 5 |
| Motilal Vigyan Mahavidayala, Bhopal | — | — | 1 | — | 1 |
| National Dairy Research Institute, Karnal | — | — | — | 3 | 3 |
| National Institute of Communicable Diseases, Delhi | — | — | — | 2 | 2 |
| National Sugar Institute, Kanpur | — | — | 2 | 1 | 3 |
| Nutrition Research Laboratory, Hyderabad | — | — | 2 | — | 2 |
| Prince of Wales Medical College, Patna | — | — | 3 | — | 3 |
| P.W.D. Soil Mechanics & Research Division, Madras | 2 | 2 | — | — | 2 |
| Rajasthan College of Agriculture, Udaipur | — | — | — | 2 | 2 |
| Ranchi Agricultural College, Ranchi | — | — | — | 1 | 1 |
| Ranchi College of Veterinary Sciences and Animal Husbandry, Ranchi | — | — | — | 1 | 1 |
| Ravenshaw College, Cuttack | 2 | 2 | — | 2 | 4 |
| Regional Engineering College, Kurukshetra | 2 | 2 | — | 2 | 4 |
| Regional Engineering College, Srinagar | 1 | — | — | 2 | 2 |
| Regional Engineering College, Warangal | 2 | 1 | — | — | 1 |
| Royal Agri-Horticultural Society, Calcutta | 2 | 2 | — | — | 2 |
| Saha Institute of Nuclear Physics, Calcutta | 2 | 3 | 3 | 1 | 7 |
| Samrat Ashok Technology Institute, Vidisha | 1 | 1 | — | — | 1 |
| Sardar Vallabhbhai Vidyapeeth, Villabh Vidyanagar, Gujarat | 2 | 2 | — | 8 | 10 |
| School of Paper Technology, Saharanpur | — | — | — | 1 | 1 |
| School of Tropical Medicine, Calcutta | 4 | 6 | — | — | 6 |
| Shri G.S. Technological Institute, Indore | 2 | 1 | — | — | 1 |
| Shri Ram Institute for Industrial Research, Delhi | 12 | 22 | — | — | 22 |
| Society of Experimental Medical Sciences, Calcutta | 1 | 1 | — | — | 1 |
| Tata Iron & Steel Co. Ltd, Jamshedpur | 1 | — | — | — | — |
| Technical Centre, Civil Aviation Dept, New Delhi | 1 | 2 | — | — | 2 |
| Textile & Allied Industries Research Association, Baroda | 2 | 1 | — | — | 1 |
| United Ram Panchal Arts College & Sarvodaya Science College, Pilavai | 1 | 1 | — | — | 1 |
| U.P. State Observatory, Nainital | 1 | 3 | — | — | 3 |
| Vallabhbhai Patel Chest Institute, Delhi | 5 | 4 | 3 | 6 | 6 |
| TOTAL | 708 | 969 | 306 | 914 | 2189 |

## STAFF, RESEARCH FELLOWS, RESEARCH PROCESSES DEVELOPED

| Laboratory | Staff | | | | | Research fellows |
|---|---|---|---|---|---|---|
| | Sci. | Tech. | Admn | Class IV | Total | |
| NCL | 275 | 204 | 96 | 198 | 773 | 64 |
| NPL | 132 | 309 | 97 | 266 | 804 | 22 |
| CFTRI | 253 | 186 | 106 | 217 | 762 | 12 |
| CFRI | 299 | 360 | 128 | 474 | 1261 | 7 |
| CGCRI | 88 | 188 | 84 | 167 | 527 | — |
| NML | 189 | 373 | 121 | 312 | 995 | 13 |
| CDRI | 143 | 157 | 73 | 197 | 570 | 22 |
| CRRI | 90 | 107 | 73 | 163 | 433 | — |
| CECRI | 120 | 197 | 52 | 139 | 508 | 7 |
| CLRI | 136 | 83 | 65 | 105 | 389 | 8 |
| CBRI | 126 | 125 | 58 | 98 | 407 | 7 |
| NBG | 86 | 137 | 60 | 313 | 596 | 9 |
| CEERI | 54 | 136 | 35 | 54 | 279 | 8 |
| CSMCRI | 95 | 72 | 38 | 75 | 280 | — |
| CMRS | 167 | 117 | 54 | 102 | 440 | 6 |
| RRL Hyd. | 190 | 335 | 81 | 294 | 900 | 37 |
| RRL Jammu | 87 | 61 | 43 | 111 | 302 | 8 |
| RRL Jorhat | 52 | 63 | 30 | 73 | 218 | 6 |
| RRL Bhu. | 30 | 31 | 16 | 34 | 111 | 2 |
| IIEM | 24 | 39 | 37 | 58 | 158 | 20 |
| BITM | 33 | 71 | 38 | 68 | 210 | — |
| CPHERI | 95 | 127 | 81 | 145 | 448 | — |
| CMERI | 209 | 274 | 75 | 161 | 719 | 3 |
| CIMPO | 20 | 91 | 50 | 149 | 310 | 1 |
| CSIO | 46 | 98 | 39 | 72 | 255 | 5 |
| IIP | 144 | 158 | 57 | 135 | 494 | 8 |
| NAL | 41 | 207 | 77 | 131 | 456 | 16 |
| NGRI | 75 | 44 | 48 | 20 | 187 | 4 |
| VITM | 1 | 35 | 11 | 11 | 58 | 8 |
| NIO | 36 | 16 | 21 | 24 | 97 | 8 |
| SERC | 38 | 16 | 6 | 15 | 75 | 3 |
| ITRC | 7 | 9 | 7 | 12 | 35 | 8 |
| Insdoc | 69 | 45 | 66 | 41 | 221 | — |
| PID | 53 | 23 | 54 | 39 | 169 | — |
| Headquarters | 8 | 102 | 256 | 107 | 473 | — |
| CDEO | 19 | 9 | 4 | 3 | 35 | — |
| RSPO | 17 | 2 | 17 | — | 36 | — |
| ILU | 3 | 13 | 8 | 3 | 27 | 1 |
| DSTP | 29 | 10 | 26 | 8 | 73 | — |
| DRCIL | 16 | — | 15 | 3 | 34 | — |



## PAPERS PUBLISHED AND PATENTS AND (LABORATORYWISE)

| Books, reports & other publications | Research papers | | | Patents filed | | | Pilot plants set-up | Processes | |
|---|---|---|---|---|---|---|---|---|---|
| | Indian Journals | Foreign Journals | Total | Indian | Foreign | Total | | Released for com. utilization | Utilized by industry |
| 1 | 27 | 37 | 64 | 4 | — | 4 | 3 | 6 | 3 |
| — | 19 | 43 | 62 | 6 | — | 6 | — | 5 | 2 |
| 1 | 17 | 3 | 20 | 2 | 1 | 3 | — | 5 | 2 |
| 15 | 55 | 2 | 57 | 6 | 3 | 9 | 3 | — | — |
| 2 | 22 | 1 | 23 | 2 | — | 2 | — | 4 | 1 |
| 4 | 50 | 6 | 56 | 5 | — | 5 | — | 9 | 1 |
| 1 | 36 | 22 | 58 | 8 | — | 8 | — | 5 | — |
| 2 | 11 | 3 | 14 | 1 | — | 1 | 2 | 2 | 1 |
| 3 | 38 | 29 | 67 | 19 | 1 | 20 | — | 6 | 2 |
| 1 | 34 | 3 | 37 | 1 | 1 | 2 | 2 | 17 | — |
| 14 | 47 | 5 | 52 | 4 | — | 4 | — | 9 | 2 |
| — | 22 | 11 | 33 | — | — | — | — | — | — |
| 2 | 7 | 12 | 19 | 3 | — | 3 | — | 2 | 1 |
| — | 34 | 1 | 35 | 3 | — | 3 | 9 | 6 | 1 |
| 2 | 2 | — | 2 | 9 | — | 9 | — | — | — |
| 4 | 24 | 23 | 47 | 5 | — | 5 | 3 | 11 | 4 |
| — | 6 | 10 | 16 | 1 | — | 1 | 2 | — | — |
| 4 | 6 | 2 | 8 | 4 | — | 4 | 3 | — | — |
| — | — | — | — | — | — | — | — | — | — |
| — | 4 | 11 | 15 | — | — | — | — | — | — |
| 5 | — | — | — | — | — | — | — | — | — |
| 6 | 40 | — | 40 | 2 | — | 2 | 3 | — | — |
| 12 | 4 | — | 4 | 9 | — | 9 | — | 11 | — |
| — | 9 | 3 | 12 | — | — | — | — | — | — |
| 3 | 11 | — | 11 | — | — | — | — | 9 | — |
| 7 | 15 | — | 15 | 3 | — | 3 | 5 | 1 | — |
| 29 | 2 | 2 | 4 | — | — | — | — | — | — |
| 3 | — | — | — | — | — | — | — | — | — |
| — | 2 | — | 2 | — | — | — | — | — | — |
| 1 | 5 | 3 | 8 | — | — | — | — | — | — |
| 3 | 6 | 1 | 7 | 1 | — | 1 | — | — | — |
| — | — | — | — | — | — | — | — | — | — |
| 12 | — | — | — | — | — | — | — | — | — |
| 30 | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — |
| 3 | — | — | — | — | — | — | — | — | — |
| 1 | — | — | — | — | — | — | — | — | — |
| 11 | — | — | — | — | — | — | — | — | — |
| 4 | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — |

## Appendix 27

### SUMMARY OF EXPENDITURE DURING THE YEAR ENDING MARCH 31, 1966

(Figures in lakhs rupees)

| Laboratory | Capital general | Staff quarters | Recurring | Pilot Plants Capital | Pilot Plants Recurring | Total |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| NCL | 12.204 | 0.015 | 46.639 | 1.396 | 4.798 | 65.052 |
| NPL | 5.133 | 0.073 | 41.896 | 3.092 | 9.332 | 59.526 |
| CFTRI | 10.599 | — | 33.816 | 2.976 | 1.553 | 48.944 |
| CFRI | 2.657 | 2.846 | 32.502 | 2.786 | 10.928 | 51.719 |
| Coal Survey Stations | — | 0.232 | 13.230 | — | — | 13.462 |
| CGCRI | 2.409 | — | 24.966 | 1.202 | 3.586 | 32.163 |
| NML | 5.818 | 3.973 | 43.887 | 7.043 | 10.508 | 71.229 |
| CDRI | 8.087 | 3.235 | 27.519 | 0.650 | 0.950 | 40.441 |
| CRRI | 2.425 | — | 22.412 | 0.114 | 1.879 | 26.830 |
| CECRI | 5.053 | — | 24.435 | 0.294 | 1.504 | 31.286 |
| CLRI | 3.094 | 0.599 | 21.779 | 2.439 | 1.471 | 29.382 |
| CBRI | 2.520 | 2.209 | 20.149 | 0.150 | — | 25.028 |
| NBG | 1.604 | — | 20.422 | — | 0.099 | 22.125 |
| CEERI | 3.344 | 2.578 | 13.600 | 1.275 | 2.870 | 23.667 |
| CSMCRI | 5.706 | 0.235 | 12.049 | 1.729 | 0.639 | 20.358 |
| CMRS | 4.441 | 0.118 | 22.343 | — | — | 26.902 |
| RRL Hyd. | 13.260 | 2.302 | 40.654 | 3.351 | 13.255 | 72.822 |
| RRL Jammu | 11.264 | 0.054 | 13.083 | 1.387 | 0.103 | 25.891 |
| RRL Jorhat | 21.994 | 0.209 | 10.969 | 1.572 | 0.126 | 34.870 |
| RRL Bhu. | 22.005 | 13.000 | 4.968 | — | — | 39.973 |
| IIEM | 5.398 | 18.570 | 10.156 | — | — | 34.124 |
| BITM | 2.017 | — | 8.091 | — | — | 10.108 |
| CPHERI | 3.220 | — | 21.787 | 0.451 | 0.245 | 25.703 |
| CMERI | 54.536 | 22.427 | 30.023 | — | — | 106.986 |
| CIMPO | 1.130 | — | 6.345 | — | — | 7.475 |
| CSIO | 13.632 | — | 17.227 | — | — | 30.859 |
| IIP | 27.922 | 7.622 | 38.401 | 0.175 | 0.024 | 74.144 |
| NAL | 160.203 | 8.125 | 26.128 | — | 0.008 | 194.464 |
| NGRI | 5.601 | 0.010 | 9.275 | — | — | 14.886 |
| VITM | 3.243 | — | 4.103 | — | — | 7.346 |
| NIO | 0.499 | — | 6.422 | — | — | 6.921 |
| MSTM | — | — | 0.188 | — | — | 0.188 |
| Insdoc | 0.650 | — | 15.745 | — | — | 16.395 |
| PID | 2.272 | — | 14.578 | — | — | 16.850 |
| CSIR Secretariat | 7.385 | 3.523 | 42.232 | — | — | 53.140 |
| SERC (R) | 2.000 | — | 4.632 | — | — | 6.632 |
| ITRC | — | — | 0.651 | — | — | 0.651 |
| Cooperative Research Associations : | | | | | | |
| ATIRA | 7.591 | — | 7.186 | — | — | 14.777 |
| SASMIRA | — | — | 3.110 | — | — | 3.110 |
| SITRA | 1.940 | — | 2.580 | — | — | 4.520 |
| IPIRA | 1.076 | — | 0.531 | — | — | 1.607 |
| TRA | 2.000 | — | 21.500 | — | — | 23.500 |
| Research Centres : | | | | | | |
| Low Shaft Furnace Project | 0.902 | — | 11.306 | — | — | 12.208 |
| School on Dyestuff Technology | — | — | 0.700 | — | — | 0.700 |
| Research School in Earthquake Engng | 2.250 | — | 2.250 | — | — | 4.500 |
| International Meteorological Centre | — | — | 0.500 | — | — | 0.500 |
| Rain & Cloud Physics Research Centre | 0.224 | — | 1.525 | — | — | 1.749 |
| Special Research Programme & Grants-in-Aid | — | — | 85.767 | — | — | 85.767 |
| Retired Emeritus Scientists | — | — | 4.592 | — | — | 4.592 |
| Fellowships/Scholarships | — | — | 15.690 | — | — | 15.690 |
| Employees' Contribution to CPF and Interest | — | — | 21.574 | — | — | 21.574 |
| Entertainment Charges | — | — | 0.108 | — | — | 0.108 |
| Scientists' Pool | — | — | 50.607 | — | — | 50.607 |
| Superannuation Allowance & Pension | — | — | 2.967 | — | — | 2.967 |
| Deputations T.A. to S.E.A. Countries | — | — | 0.085 | — | — | 0.085 |
| Defence Projects | — | — | 1.063 | — | — | 1.063 |
| Scientific & Technical Cooperation with Foreign Countries | — | — | 0.405 | — | — | 0.405 |
| Visits of Foreign Scientists | — | — | 0.495 | — | — | 0.495 |
| Conveyance Advance | — | — | 4.386 | — | — | 4.386 |
| House Building Advances | — | — | 1.761 | — | — | 1.761 |
| Maintenance of Staff Quarters | — | — | 4.138 | — | — | 4.138 |
| S.S.B. Memorial Fund | — | — | 0.921 | — | — | 0.921 |
| TOTAL | 449.679 | 91.955 | 998.193 | 32.082 | 63.878 | 1635.787 |

## COUNCIL OF SCIENTIFIC &

## CONSOLIDATED STATEMENT OF RECEIPT

### RECEIPTS

| | | | Rs |
|---|---|---|---|
| 1. | OPENING BALANCE | | 99,63,483.50 |
| 2. | LUMPSUM GRANTS FROM GOVERNMENT | | |
| | (i) Capital | 6,13,67,155.89 | |
| | (ii) Recurring | 9,46,74,400.00 | 15,60,41,555.89 |
| 3. | DONATION AND CONTRIBUTION | | |
| | (i) Coal Board : Capital | 2,00,000.00 | |
| | Recurring | 2,13,000.00 | |
| | (ii) Govt of Andhra Pradesh | 2,00,00.000 | |
| | (iii) Tea Board for Tea Res. Assn | 8,85,898.25 | |
| | (iv) From Other Sources | 1,048.75 | 14,99,947.00 |
| 4. | MISCELLANEOUS RECEIPTS | | |
| | (i) Central Office | 8,38,315.69<br>$30.50 | |
| | (ii) Laboratories /Institutes | 52,64,849.87<br>61,03,165.56 | $ 30.50 |
| | (iii) Deduct Refunds | 16,896.89 | 60,86,268.67 |
| 5. | G-DEPOSITS & ADVANCES | | |
| | (i) Deposits of Outside Parties for financing their schemes | | |
| | (a) Central Office | 11,43,711.79 | |
| | (b) Laboratories/Institutes | 43,54,607.46 | |
| | (c) Scholarships sponsored by Assam Oil/ Burmah Shell Cos. | 1,75,000.00 | 56,73,319.25 |
| | (ii) Security Deposits/E. Money | | |
| | (a) Central Office | 2,849.00 | |
| | (b) Laboratories/Institutes | 17,15,782.28 | 17,18,631.28 |
| | (iii) Caution Money (Labs./Instts.) | | 7,022.50 |
| | (iv) Conveyance Advance | | |
| | (a) Central Office | 44,425.65 | |
| | (b) Laboratories/Institutes | 3,21,880.22 | 3,66,305.87 |
| | (v) Festival Advance | | |
| | (a) Central Office | 14,013.00 | |
| | (b) Laboratories/Institutes | 5,01,795.87 | 5,15,808.87 |
| | (vi) House Bldg. Advance | | |
| | (a) Central Office | 1,403.00 | |



## INDUSTRIAL RESEARCH

## AND PAYMENT ACCOUNT FOR THE YEAR 1965-66

### PAYMENTS

| | | | | Rs |
|---|---|---|---|---|
| 1. | RECURRING | | | |
| | (A) Pay & Allowances | | | |
| | (i) Central Office | | 28,69,609.00 | |
| | (ii) Laboratories/Institutes | | 4,75,58,466.70 | 5,04,28,075.70 |
| | (B) Contingencies | | | |
| | (i) Central Office | | 14,14,194.69 | |
| | (ii) Laboratories/Institutes | | 1,15,99,623.44 | 1,30,13,818.13 |
| | (C) Maintenance | | | |
| | (i) Central Office | | 31,389.62 | |
| | (ii) Laboratories/Institutes | | 5,46,912.89 | 5,78,302.51 |
| | (D) Apparatus & Equipment | | | |
| | (i) Apparatus & Equipment | | 27,42,621.36 | |
| | (ii) Chemicals | | 18,25,275.96 | |
| | (iii) Workshop Stores | | 20,25,234.42 | |
| | (iv) Other Misc. Stores | | 38,24,358.01 | |
| | (v) Models & Exhibits | | 39,299.87 | |
| | (vi) Experiments & Field Investigations | | 3,45,191.88 | 1,08,01,981.50 |
| | (E) Scientists' Pool | | | |
| | (i) Central Office | | 45,96,154.25 | |
| | (ii) Laboratories/Institutes | | 4,64,578.96 | 50,60,733.21 |
| | (F) J-Superannuation Pension & Allowances | | | |
| | (i) Central Office | | 73,735.64 | |
| | (ii) Laboratories/Institutes | | 2,22,991.35 | 2,96,726.99 |
| | (G) Entertainment Charges | | | 10,797.08 |
| | (H) Visit of Foreign Scientists | | | 49,459.31 |
| | (I) Deputation of Scientists to Foreign Countries | | | 8,534.59 |
| | (J) Scientific & Tech. Cooperation with Foreign Countries | | | 40,546.10 |
| | (K) Fellowships/Scholarship/Deputations | | | |
| | (i) Central Office | | 35,842.15 | |
| | (ii) Laboratories/Institutes | | 15,33,115.65 | 15,68,957.80 |
| | (L) Defence Projects | | | 1,06,272.81 |
| | (M) Losses Writen off | | | 1.15 |
| | (N) Council's Contri. & Intt. on Deposits | | | 21,57,372.00 |
| | (O) Maintenance of Staff Quarters | | | 4,13,807.65 |
| | (P) National Biological Laboratory | | | 110.00 |

# CONSOLIDATED STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR 1965-66

## RECEIPTS

| | | | Rs |
|---|---|---|---|
| (vii) O.B. Advance (Labs./Instts.) | | | 3,60,579.78 |
| (viii) Permanent Advance (Labs./Instts.) | | | 3,300.00 |
| (ix) Royalties & Premia | | | |
| (a) Central Office | 3,11,679.73 | | |
| (b) Laboratories/Institutes | 27,324.80 | | 3,39,004.53 |
| (x) Fan Advance | | | |
| (a) Central Office | 260.00 | | |
| (b) Laboratories/Institutes | 27,812.00 | | 28,072.00 |
| (xi) Other Deposits | | | 5,04,312.90 |
| (xii) Govt. Loan for Drug Farms & Factories | | | 5,00,000.00 |
| 6. C.P. FUND/G.P. FUND | | | 46,09,853.49 |
| 7. PENSION FUND | | | 1,13,154.00 |
| 8. H-SUSPENSE | | | |
| (a) Central Office | 1,68,190.96 | | |
| (b) Laboratories/Institutes | 39,40,663.51 | | 41,08,854.47 |
| 9. I-REMITTANCE | | | |
| (a) Central Office | 6,06,976.36 | | |
| (b) Laboratories/Institutes | 88,21,150.90 | | 94,28,127.26 |

## PAYMENTS

| | | | Rs |
|---|---|---|---|
| (Q) New Institutes/Research Centres | | | |
| (i) Central Office | 3,45,046.39 | | |
| (ii) Laboratories/Institutes | 13,05,534.96 | | 16,50,581.35 |
| (R) Special Research Programme & Grant-in-Aid | | | |
| (i) Central Office | 85,05,093.68 | | |
| (ii) Laboratories/Institutes | 71,682.46 | | 85,76,776.14 |
| (S) Grants-in-Aid to Retired/Emeritus Scientists | | | |
| (i) Central Office | 4,41,845.48 | | |
| (ii) Laboratories/Institutes | 17,334.55 | | 4,59,180.03 |
| (T) Cooperative Res. Associations | | | 40,05,127.00 |
| 2. CAPITAL | | | |
| (A) (i) Works | | | |
| (a) Central Office | 6,53,349.66 | | |
| (b) Laboratories/Institutes | 94,10,116.42 | | 1,00,63,466.08 |
| (ii) Services | | | |
| (a) Central Office | 51,697.11 | | |
| (b) Laboratories/Institutes | 43,33,767.66 | | 43,85,464.77 |
| (iii) Plant & Machinery | | | 12,98,044.26 |
| (iv) Apparatus & Equipment | | | 2,40,79,561.74 |
| (v) Books & Periodicals | | | |
| (a) Central Office | 33,458.41 | | |
| (b) Laboratories/Institutes | 6,47,815.73 | | 6,81,274.14 |
| (vi) Furniture & Fittings | | | 14,44,114.82 |
| (vii) Vehicles & Transport | | | 5,26,242.69 |
| (viii) Models & Exhibits | | | 2,90,843.75 |
| (ix) Other Misc. Stores | | | 5,63,503.78 |
| (B) Grants-in-Aid (Capital) | | | |
| (i) Cooperative Res. Associations | | | 12,97,773.00 |
| (ii) New Res. Instt. & Centres | | | |
| (a) Central Office | 2,25,000.00 | | |
| (b) Laboratories/Institutes | 90,160.85 | | 3,15,160.85 |
| (C) Pilot Plant | | | |
| (i) Staff Pay & Allowances | 30,70,105.77 | | |
| (ii) Contingencies | 16,67,926.29 | | |
| (iii) Equipment | 24,61,281.28 | | |
| (iv) Building & Services | 7,46,804.97 | | |

## CONSOLIDATED STATEMENT OF RECEIPTS &

## PAYMENTS FOR THE YEAR 1965-66

| RECEIPTS | Rs | PAYMENTS | | Rs |
|---|---|---|---|---|
| | | (D) Staff Quarters | | |
| | | (i) Pay & Allowances | | |
| | | (a) Central Office | 3,16,496.77 | |
| | | (b) Laboratories/Institutes | 2,20,829.91 | 5,37,326.68 |
| | | (ii) Contingencies | | |
| | | (a) Central Office | 35,765.22 | |
| | | (b) Laboratories/Institutes | 32,020.95 | 67,786.17 |
| | | (iii) Works & Services (Labs./Instts.) | | 85,90,387.84 |
| | | 3. DEPOSITS & ADVANCES | | |
| | | (A) Payments from Deposits of Outside Parties for financing their Schemes | | |
| | | (i) Central Office | 21,42,572.41 | |
| | | (ii) Laboratories/Institutes | 37,38,524.22 | |
| | | (iii) Scholarships Sponsored by Burmah Shell/ Assam Oil Cos. | 2,65,596.55 | 61,46,693.18 |
| | | (B) Security Deposits/Earnest Money/Retention Money | | |
| | | (i) Central Office | 25,290.00 | |
| | | (ii) Laboratories/Institutes | 16,87,766.54 | 17,13,056.54 |
| | | (C) Caution Money | | 6,650.00 |
| | | (D) Conveyance Advance | | |
| | | (i) Central Office | 63,047.50 | |
| | | (ii) Laboratories/Institutes | 3,75,568.55 | 4,38,616.05 |
| | | (E) Festival Advance | | |
| | | (i) Central Office | 13,532.00 | |
| | | (ii) Laboratories/Institutes | 5,54,806.50 | 5,68,338.50 |
| | | (F) Fan Advance | | |
| | | (i) Central Office | 100.00 | |
| | | (ii) Laboratories/Institutes | 27,498.20 | 27,598.20 |
| | | (G) House Bldg. Advance | | |
| | | (i) Central Office | 50,205.00 | |
| | | (ii) Laboratories/Institutes | 1,25,868.00 | 1,76,073.00 |
| | | (H) Royalties & Premia | | |
| | | (i) Central Office | 1,99,862.47 | |
| | | (ii) Laboratories/Institutes | 21,533.20 | 2,21,395.67 |
| | | (I) Permanent Advance | | |
| | | (i) Central Office | 2,625.00 | |

## CONSOLIDATED STATEMENT OF RECEIPTS & PAYMENTS FOR THE YEAR 1965-66

### RECEIPTS

| | Rs |
|---|---|
| TOTAL | $30.50<br>20,18,75,657.26 |

### PAYMENTS

| | | Rs |
|---|---|---|
| (J) O.B. Advance Laboratories/Institutes | | 2,70,412.07 |
| (K) Flood Advance | | 104.00 |
| (L) Other Misc. Advances | | |
| (i) Central Office | 150.00 | |
| (ii) Laboratories/Institutes | 7,43,782.50 | 7,43,932.50 |
| (M) Payment to Drug Farms/Factories | | 7,00,000.00 |
| 4. C. P. FUND/G.P. FUND | | |
| (i) Investment during the year | 43,00,000.00 | |
| (ii) Less Encashment | 6,05,000.00 | |
| | 36,95,000.00 | |
| (iii) Final Refunds/Advances | 10,51,970.53 | 47,46,970.53 |
| 5. H-SUSPENSE | | |
| (i) Central Office | 2,56,974.07 | |
| (ii) Laboratories/Institutes | 29,96,301.69 | 32,53,275.76 |
| 6. I-REMITTANCE | | |
| (i) Central Office | 5,78,958.40 | |
| (ii) Laboratories/Institutes | 89,42,482.48 | 95,21,440.88 |
| 7. CLOSING BALANCE AS ON MARCH 31, 1966 | | |
| (i) Cash at Bank | $30.50<br>93,80,882.08 | $ 30.50 |
| (ii) Funds in Transit | 9,90,000.00 | 1,03,70,882.08 |
| TOTAL | | $ 30.50<br>20,18,75,657.26 |

(*Sd*) RADHEY SHIAM

(*Sd*) R. C. SEKHER
*BUDGET & ACCOUNTS OFFICER*

(*Sd*) K. G. KRISHNAMURTHI
*SECRETARY*

## COUNCIL OF SCIENTIFIC &

## CONSOLIDATED INCOME & EXPENDITURE

### EXPENDITURE

| | | | Rs |
|---|---|---|---|
| 1. | PAY & ALLOWANCES | | |
| | (a) Pay of Officers | 1,49,24,114 | |
| | (b) Pay of Estt. | 2,00,27,785 | |
| | (c) Allowances | 1,54,76,177 | 5,04,28,076 |
| 2. | CONTINGENCIES | | 1,15,25,213 |
| 3. | MAINTENANCE | | 5,11,687 |
| 4. | CHEMICALS & CONSUMABLE STORES | | 81,14,281 |
| 5. | GRANTS-IN-AID | | |
| | (a) Central Office | 1,48,19,886 | |
| | (b) Laboratories/Institutes | 13,72,138 | 1,61,92,024 |
| 6. | SCIENTISTS' POOL | | 50,60,733 |
| 7. | FELLOWSHIPS | | 15,68,958 |
| 8. | SUPERANNUATION ALLOWANCES & PENSION | | 2,96,727 |
| 9. | ENTERTAINMENT | | 10,797 |
| 10. | VISIT OF FOREIGN SCIENTISTS | | 49,459 |
| 11. | DEPUTATION OF SCIENTISTS TO FOREIGN COUNTRIES | | 8,535 |
| 12. | SCIENTIFIC & TECH. COOPERATION WITH FOREIGN COUNTRIES | | 40,546 |
| 13. | CONTRIBUTION TOWARDS C.P.F. AND INTEREST ON DEPOSITS | | 21,57,372 |
| 14. | DEFENCE PROJECT | | 85,113 |
| 15. | NATIONAL BIOLOGICAL LABORATORY | | 110 |
| 16. | STAFF QUARTERS | | |
| | (a) Pay & Allowances | 4,52,898 | |
| | (b) Contingencies | 51,856 | |
| | (c) Maintenance | 3,92,838 | 8,97,592 |
| 17. | PILOT PLANT | | |
| | (a) Pay & Allowances | 30,70,106 | |
| | (b) Raw Materials | 16,49,823 | |
| | (c) Contingencies | 16,46,303 | 63,66,232 |
| 18. | LOSSES WRITTEN OFF | | 1,42,226 |
| | | TOTAL | 10,34,55,681 |

(*Sd*) RADHEY SHIAM
*ASST. ACCOUNTS OFFICER*

(*Sd*) R. C. SEKHER
*BUDGET & ACCOUNTS*



## INDUSTRIAL RESEARCH

## ACCOUNT FOR THE YEAR 1965-66

### INCOME

| | | | Rs |
|---|---|---|---|
| 1. | RECURRING GRANT FROM GOVERNMENT | | 9,46,74,400 |
| 2. | CASH DONATIONS & CONTRIBUTIONS FROM | | |
| | (a) Coal Board | 2,13,000 | |
| | (b) Govt of Andhra Pradesh | 2,00,000 | |
| | (c) Tea Board for Tea Res. Assn | 8,85,898 | |
| | (d) Other sources | 1,049 | 12,99,947 |
| 3. | MISCELLANEOUS RECEIPTS | | |
| | (a) Analytical & Testing Charges | 7,91,090 | |
| | (b) Sale Proceeds of Labs. Products | 3,90,806 | |
| | (c) do Pilot Plant | 10,43,597 | |
| | (d) do Priced Pub. | 1,87,184+$30.50 | |
| | (e) do Tender Paper | 4,599 | |
| | (f) do Fruit & Vegetab. | 48,334 | |
| | (g) do Scheme Products | 6,353 | |
| | (h) do Unserviceable store | 36,230 | |
| | (i) do Empties | 49,143 | |
| | (j) Rent of Premises | 16,643 | |
| | (k) Rent of Staff Quarters | 11,29,684 | |
| | (l) Interest on Conveyance & Fans Adv. | 14,765 | |
| | (m) Private use of Transport | 49,110 | |
| | (n) Contribution towards Pension/CPF/Leave Salary | 2,15,936 | |
| | (o) Application Fee | 79,702 | |
| | (p) Tuition Fee | 27,951 | |
| | (q) Income from Investment | 3,57,296 | |
| | (r) Refund of Unspent Balance | 1,12,827 | |
| | (s) Water & Electricity Charges | 36,563 | |
| | (t) Advertisement Charges | 34,176 | |
| | (u) Royalties & Premia | 2,33,760 | |
| | (v) Collaboration Charges | 1,08,850 | |
| | (w) Microfilm Services | 99,352 | |
| | (x) Misc. Receipts | 10,29,214 | $30.50 |
| | (y) Deduct Refunds | (—)16,897 | 60,86,268 |
| | EXCESS OF EXPENDITURE OVER INCOME | | 13,95,066 |
| | | | (—)$30.50 |
| | | TOTAL | 10,34,55,681 |

(*Sd*) K. G. KRISHNAMURTHI
*SECRETARY*

## COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

### CONSOLIDATED STATEMENT OF BALANCE SHEET AS ON MARCH 31, 1966

#### LIABILITIES

| *As on March 31, 1965* | *Particulars* | | *As on March 31, 1966* |
|---|---|---|---|
| | 1. CAPITAL | | |
| 26,04,52,300 | (a) Govt Grant for Capital Expenditure | | 32,18,19,456 |
| 1,71,04,123 | (b) Out of Recurring Grant | | 1,71,04,123 |
| 26,81,151 | (c) Cash Donation for Capital Expenditure from Coal Board | | 28,81,151 |
| 67,51,516 | (d) Cash Donation from Pvt. Industries for Capital Expenditure | | 67,51,516 |
| 2,68,39,400 | (e) Reserve (Value of Gifts in kind) | | 2,96,91,852 |
| | | | $30.50 |
| 35,30,151 | 2. EXCESS OF INCOME OVER EXPENDITURE | | 21,35,085 |
| | 3. DEPOSITS | | |
| 27,31,571 | (a) Security Deposit | | 26,08,898 |
| 19,34,017 | (b) Deposits Received for financing outside Schemes | | 15,78,379 |
| 14,29,376 | (c) Other Misc. Deposits | | 17,42,295 |
| 7,24,000 | (d) Central Govt. Loan | | 11,44,326 |
| 2,23,23,765 | 4. C.P.F. | 1,67,80,031 | |
| | G.P.F. | 91,01,617 | 2,58,81,648 |
| 33,74,692 | 5. PENSION FUND | | 34,87,846 |
| 54,150 | 6. IMPREST | | 57,450 |
| 34,99,30,212 | | | $30.50<br>41,68,84,025 |

(*Sd*) RADHEY SHIAM
*ASST. ACCOUNTS*

(*Sd*) R. C. SEKHER
*BUDGET & ACCOUNTS*

Appendix 30

#### ASSETS

| *As on March 31, 1965* | *Particulars* | | *As on March 31, 1966* |
|---|---|---|---|
| | 1. FIXED ASSETS | | |
| 11,71,66,032 | (a) Land and Bldg. | | 13,28,29,861 |
| 3,82,64,703 | (b) Staff quarters | | 4,70,94,629 |
| 7,05,56,770 | (c) Equipment & Apparatus | | 9,64,83,756 |
| 2,78,70,809 | (d) Plant & Machinery | | 2,99,39,271 |
| 35,13,654 | (e) Office Equipment | | 40,14,506 |
| 86,88,599 | (f) Furniture & Fitting | | 1,02,41,270 |
| 35,11,430 | (g) Vehicles & Transport | | 41,54,072 |
| 1,16,84,564 | (h) Library Books | | 1,33,25,916 |
| 13,24,803 | (i) Models & Exhibits | | 16,56,289 |
| | (j) Pilot Plant | | |
| | (i) Land & Bldg. | 46,18,930 | |
| 1,75,48,912 | (ii) Equipment | 1,68,50,776 | 2,14,69,706 |
| 82,59,969 | (k) Workshop Stores | | 95,56,655 |
| 2,22,162 | (l) Defence Projects | | 2,43,322 |
| 2,16,60,000 | 2. C.P.F./G.P.F. INVESTMENT | | 2,53,55,000 |
| 1,35,407 | 3. REMITTANCE ACCOUNT | | 1,52,549 |
| | 4. LOANS & ADVANCES | | |
| 5,71,374 | (a) Conveyance Purchase Advance | | 6,38,587 |
| 1,87,058 | (b) Festival Advance | | 2,14,822 |
| 78,38,853 | (c) Other Misc. Advances | | 73,98,227 |
| 1,83,480 | (d) House Bldg. Advances | | 3,42,929 |
| 7,24,000 | (e) Loans to CIMPO Farms, Ceramics and Hostel | | 13,44,326 |
| | 5. CASH & BANK BALANCE | | |
| 54,150 | (a) Imprest | $30.50 | 57,450 |
| 99,63,483 | (b) Cash at Bank | 93,80,882 | |
| | Funds in Transits | 9,90,000 | $30.50 |
| | | | 1,03,70,882 |
| 34,99,30,212 | | | 41,68,84,025<br>$30.50 |

(*Sd*) K. G. KRISHNAMURTHI
*SECRETARY*

## Appendix 31

### CONTINGENT EXPENDITURE DURING 1965-66

(in lakhs rounded off to hundreds)

| | | | |
|---|---|---|---|
| 1. Freight & Custom | 1.154 | 20. Hot & Cold Weather Charges | 0.120 |
| 2. Cartage & Coolies Charges | 0.416 | 21. Bank Charges | 0.155 |
| 3. Stationery & Printing | 14.937 | 22. Tech. Coop./Colombo Plan, etc. | 1.917 |
| 4. Advertisement Charges | 6.357 | 23. Light Refreshment & Entertainment Charges | 0.611 |
| 5. Water & Electricity Charges | 21.333 | 24. Photographic Stores | 1.156 |
| 6. Gas | 2.499 | 25. Audit Fee | 0.574 |
| 7. Office Equipment | 4.779 | 26. Grants-in-Aid to Clubs | 0.199 |
| 8. Telephones | 4.785 | 27. C. H. S. S. | 2.591 |
| 9. Liveries & Blankets | 2.792 | 28. Furniture | 0.379 |
| 10. Daily Wages | 6.189 | 29. Vehicles | 0.282 |
| 11. Postage | 4.758 | 30. Cost of Binding, Printing of Publications | 3.345 |
| 12. Books & Periodicals | 13.704 | 31. Rent of Building | 3.538 |
| 13. Petrols & Mobiloils | 7.591 | 32. Law Charges | 0.073 |
| 14. Municipal Taxes | 2.974 | 33. Emergency Risk Insurance | 0.415 |
| 15. Garden Purchases | 1.749 | 34. Exhibition/Seminar | 0.752 |
| 16. Washings | 0.297 | 35. Stamp Duty | 0.015 |
| 17. Diff. of H/Rent | 4.719 | 36. Patent Fee | 0.425 |
| 18. Miscellaneous | 10.123 | TOTAL | 1,30.138 |
| 19. Medicines | 2.435 | | |

| | | |
|---|---|---|
| (*Sd*) RADHEY SHIAM | (*Sd*) R. C. SEKHER | (*Sd*) K.G. KRISHNAMURTHI |
| *ASST. ACCOUNTS OFFICER CSIR* | *BUDGET & ACCOUNTS OFFICER, CSIR* | *SECRETARY CSIR* |

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## AUDIT CERTIFICATE

I have examined the foregoing accounts and the Balance Sheet of the Council of Scientific & Industrial Research, and obtained all the information and explanations that I have required and subject to the observations in the Audit Report appended, I certify, as a result of my audit, that in my opinion these accounts and the Balance Sheet are properly drawn up so as to exhibit a true and fair view of the state of affairs of the Council of Scientific & Industrial Research according to the best of my information and explanations given to me and as shown by the books of the Council of Scientific & Industrial Research, New Delhi.

New Delhi
Dated the 27 June, 1967

Sd/- D. D. DHINGRA
Accountant General
Central Revenues

*Countersigned*

New Delhi
Dated the 27 June, 1967

Sd/- S. RANGANATHAN
Comptroller and Auditor
General of India

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