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COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
NEW DELHI

Shri D. Bhushan

annual report
1978-79

COUNCIL OF SCIENTIFIC &
INDUSTRIAL RESEARCH
NEW DELHI

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

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COUNCIL'S ESTABLISHMENTS

PHYSICAL AND EARTH SCIENCES	
National Physical Laboratory, New Delhi	(NPL)
Central Electronics Engineering Research, Institute, Pilani	(CEERI)
Central Scientific Instruments Organisation, Chandigarh	(CSIO)
National Geophysical Research Institute, Hyderabad	(NGRI)
National Institute of Oceanography, Dona Paula, Goa	(NIO)
CHEMICAL SCIENCES	
National Chemical Laboratory, Pune	(NCL)
Central Electrochemical Research Institute, Karaikudi	(CECRI)
Central Salt & Marine Chemicals Research Institute, Bhavnagar	(CSMCRI)
Regional Research Laboratory, Hyderabad	RRL, (H)
Regional Research Laboratory, Jorhat	(RRL, Jorhat)
BIOLOGICAL SCIENCES	
Central Food Technological Research Institute, Mysore	(CFTRI)
Central Drug Research Institute, Lucknow	(CDRI)
Central Leather Research Institute, Madras	(CLRI)
National Botanical Research Institute, Lucknow	(NBRI)
Indian Institute of Experimental Medicine, Calcutta	(IIEM)
Central Institute of Medicinal & Aromatic Plants, Lucknow	(CIMAP)
Industrial Toxicology Research Centre, Lucknow	(ITRC)
Centre for Cellular and Molecular Biology, RRL, Hyderabad	(CCMB)
Regional Research Laboratory, Jammu	(RRL, Jammu)
Tea Research Association, Jorhat	(TRA)
ENGINEERING SCIENCES	
Central Glass & Ceramic Research Institute, Calcutta	(CGCRI)
National Metallurgical Laboratory, Jamshedpur	(NML)
Central Mining Research Station, Dhanbad	(CMRS)
Central Mechanical Engineering Research Institute, Durgapur	(CMERI)
National Environmental Engineering Research, Institute, Nagpur	(NEERI)
National Aeronautical Laboratory, Bangalore	(NAL)
Structural Engineering Research Centre, Madras	(SERC)
Regional Research Laboratory, Bhubaneswar	(RRL, Bhu)
Regional Research Laboratory, Trivandrum	(RRL, Trivandrum)
INFORMATION SCIENCES	
Publications & Information Directorate, New Delhi	(PID)
Indian National Scientific Documentation Centre, New Delhi	(Insdoc)
INDUSTRIAL RESEARCH ASSOCIATIONS	
Tea Research Association, Calcutta	(TRA)
Electrical Research & Development Association, Bombay	(ERDA)

INTRODUCTION

In this report CSIR's contribution to industry has been highlighted. The contribution of CSIR to rural development has been reported along with achievements in the small scale and village industries sectors. A number of projects on resource prospecting and development of materials were undertaken by the national laboratories. An account of these has been given separately under a new section 'Other Activities'. Major national facilities created in the laboratories continued to be utilised by institutions for a wide range of technical purposes. These and the programmes under way in the laboratories in collaboration with universities/higher academic institutions have been dealt with separately.

Another new feature of this report is the section on 'Design and Consultancy Capabilities in National Laboratories' specifically introduced for the benefit of the industry.

The projects covered under 'Basic Research' are mainly application-oriented and of long-term value. This is but natural for in an organisation devoted to industrial research the emphasis on basic research centres around investigations leading to application at some stage or the other.

The appendices deal with processes which have gone into production and released for the first time, and patents.

As per the decision of the Government, with effect from 1.4.78, the Research Associations (excepting the Tea Research Association and the Electrical Research & Development Association) have been attached to the Ministry of Industry and four national laboratories—the Central Building Research Institute (CBRI), Roorkee, the Central Fuel Research Institute (CFRI), Jealgora, the Central Road Research Institute (CRRI), New Delhi, and the Indian Institute of Petroleum (IIP), Dehra Dun—have been delinked from CSIR and attached to the respective user ministries. The science museums have also been delinked and attached to the Ministry of Education. They do not, therefore, find mention in this report.

The national laboratories make available various types of data and information on a wide range of subjects to industries on request. A large number of technical enquiries are also attended to. The information generated as a result of these enquiries has been of considerable benefit to the industries, particularly to those in the small sector. Their technical problems are solved and increase in productivity has been noted. In addition, the laboratories with the infrastructure available with them, undertake testing, analysis and standardisation jobs for and on behalf of industrial units which otherwise may have to go without them or seek such aid from outside the country. This aspect of technical aid to the small scale sector at nominal cost has become a part of the total programme of a laboratory. The details of these technical enquiries could be found in the annual reports of the respective laboratories.

INTRODUCTION

Arising out of the R&D work and technical activities of laboratories, considerable amount of information is generated. This addition to existing knowledge finds outlet in the form of papers, technical and feasibility reports, special reports and data periodically brought out by the laboratories. The nature of publication and the extent of information put out by laboratories vary and cover a wide spectrum. The details of the publication activities of laboratories are also available in the reports of the respective laboratories.

The extension centres, field stations and experimental units of the national laboratories in different parts of the country continued to render assistance of a wide ranging nature to the industries in and around where they are situated. These units have played a vital role in dissemination of latest technology to production units, given them on the spot advice and picked up problems for research. Ten Polytechnological Transfer Centres (PTCs) have also been set up in State Capitals with the financial participation of the State Governments and industries.

It is hoped that the report in this form will give a good idea of the progress made by CSIR laboratories in different fields.

RESEARCH UTILISATION AT A GLANCE

The researches carried out in and the capabilities of the CSIR laboratories are utilised in different ways and at various levels. The laboratories provide considerable information to industries on request and also answer their technical enquiries. As a result of the information made available and the expert advice provided, industries derived considerable benefits both in removing their technical difficulties as well as increasing productivity. Arising out of the enquiries referred to the laboratories, a certain amount of technical work is also carried out at the laboratories and results passed on to industries. These are described briefly. The contributions can be evaluated in two ways: (i) by the premia/royalty or lumpsum received by the laboratories, and (ii) by the total turnover of the industry and the overall contribution it has made to the national economy. In evaluating the contribution of CSIR to industries both factors are to be reckoned.

During the year, forty-nine processes went into production (Appendix I) and sixty-six processes were released to industry for the first time (Appendix II). The total number of processes released to industry till the end of the year was 1175 out of which about 500 processes were reported to be in production.

Pilot plants for the following products based on CSIR technologies were set up in Burma under the Indian Technical and Economic Cooperation programme of the Government of India.

1. Menthol (RRL, Jammu)
2. Electrolytic manganese dioxide (NML, Jamshedpur)

During the year, 618 sponsored research schemes having a contract value of over Rs 620 lakhs were in operation in the CSIR laboratories. Work on 211 schemes was completed.

The laboratories had 387 consultancy assignments valued at more than Rs 149 lakhs; 157 assignments were completed.

Patents

During the year 113 patent applications were filed, 95 patents accepted and 92 patents sealed in India (Appendix III).

Premia/royalties received through the National Research Development Corporation (NRDC) for the last three years were as follows:-

(Rs in lakhs)

	1976-77	1977-78	1978-79
Premia	7.167	6.452	4.112
Royalty	29.455	53.328	37.933
Total	36.622	59.770	42.045

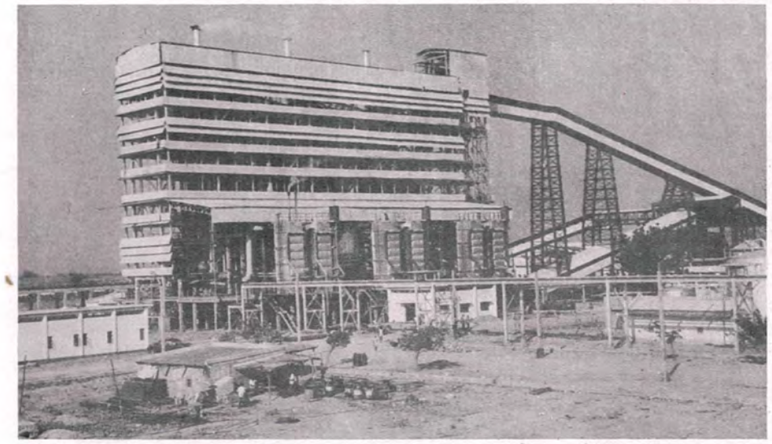
BENEFITS TO INDUSTRY

Assistance rendered to the public sector varies in terms of scale and quantum of work. The laboratories have undertaken major turn-key projects and provided basic designs for processes to the public sector industries. Another important component is work relating to survey of raw materials, their beneficiation and large scale testing facilities for the benefit of industry. The latter activities are of continuous nature and have resulted in more effective utilisation of available raw materials and natural resources and increased productivity. Some idea of the different ways in which the laboratories have rendered assistance during the course of the year to the public sector, large and medium scale and the small scale industries at various levels could be had herein.

A special mention may be made of CSIR's role in the development of medium and small scale industries. This activity occupies a significant place in the work of laboratories and consumes considerable time and resources. The return from this may appear marginal in terms of money, but when evaluated in terms of making these industries viable, adding to the number and value of products produced and raising technological capabilities and potential of the country, it would turn out to be substantial.

PUBLIC SECTOR

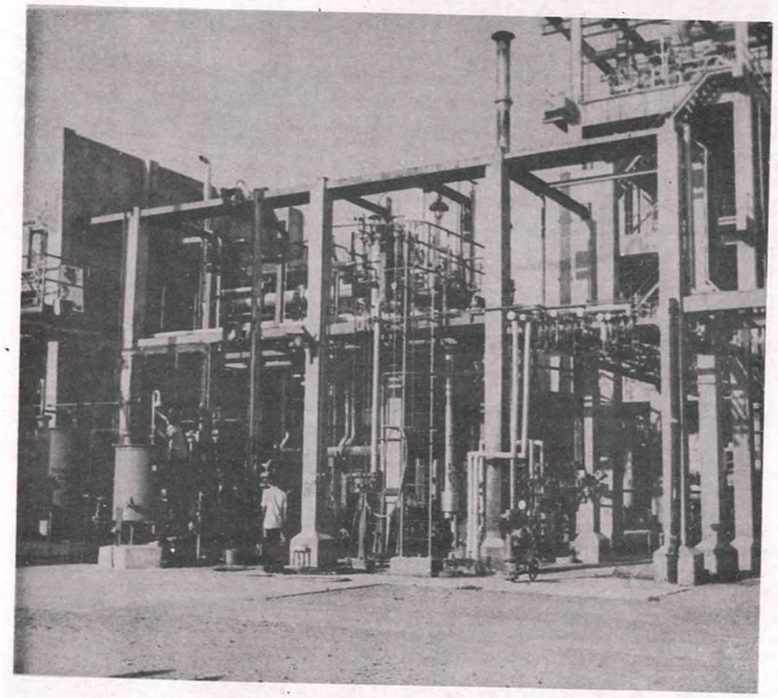
A 900 tonnes per day (tpd) plant for low temperature carbonisation (LTC) of non-coking Indian coals has gone on stream at Naspur in Adilabad district, Andhra Pradesh. The plant put up by M/s Singareni Collieries Company Limited (SCC) produces sized smokeless fuel for domestic/industrial uses and



900 t/p/day Low temperature carbonisation plant for M/s Singareni Collieries Company Ltd. (L.T.C. Plant) at Naspur, Distt. Adilabad, Andhra Pradesh

recovers all the liquid by-products; the smokeless semi-coke so produced would replace wood charcoal, leading to conservation of forests. This Rs. 12.6 crore project is based on the technological know-how and extended basic designs provided by RRL (H). The entire plant was indigenously fabricated. M/s Engineering Products (India) Limited (EPI) have been the turnkey project engineers in this achievement. The ultimate capacity of the plant will be 2700 tpd and some of the infrastructure facilities have already been provided for this capacity. RRL (H), SCC and EPI together are now capable of designing and building such plants in India and abroad competitively.

Cyclohexane, produced by catalytic hydrogenation of benzene, is the main raw material for the production of caprolactam. RRL(H) has developed process know-how and also a catalyst for the conversion of benzene to cyclohexane, and leased the process details to M/s Gujarat State Fertilizers Company Ltd., Baroda (GSFC). Based on the RRL(H) process, catalyst and process design, GSFC have erected and commissioned a 1 tpd pilot plant at Jawaharnagar, Baroda.



GSFC—1 t/p/d cyclohexane plant based on RRL, Hyderabad know-how, process engineering and catalyst

The plant went on stream in August 1978 and the catalyst performance has proved excellent. It may be noted that GSFC already have a commercial cyclohexane plant based on imported know-how, engineering and catalyst. It will now be possible for GSFC to use the RRL(H) catalyst in their commerical plant and also engineer future commercial plants both for their use as well as for sale, based on RRL(H) know-how and catalyst. It might also be possible to enter the export market for this technology which has a good demand.

Based on NML's investigations on high temperature creep resistant steels, four grades of indigenous steels for steam turbine bolting applications and super heater tubes for high tempetature service have been accepted as import substitutes. This was also due to interaction among NML, Bharat Heavy Electricals and Steel producers through the Indian Creep Panel. Foreign exchange of about Rs. 3 crores per annum is expected to be saved with the production and utilization of these grades of steels.

CFTRI has supplied 4995 units (each unit adequate for 10,000 bottles of beverage) of '77' beverage concentrate to M/s Modern Bakeries. The Institute also undertook fumigation of wheat stocks of Food Corporation of India (FCI) at Avadi (Tamil Nadu), Nanjangud and Krishnarajanagar (Karnataka) besides testing the permeability of methyl bromide and phosphine through high-density poly-ethylene (for use as fumigation cover) for the Karnataka State Warehousing Corporation. The Technical Consultancy Services Organisation of the Karnataka Government (TECSOK) is being assisted by the Institute in setting up a food industries complex at Mysore.

High pressure screw compressor rotors were developed by CMERI for replacement in imported compressors of the Rourkela Steel Plant using special cutters designed by the Institute. This is an import substitution item.

In collaboration with CFRI, Dhanbad, CMERI has developed a paddy husk combustor for the Food Corporation of India. Most of the modern rice mills use furnace oil for the purpose of drying, and furnace oil being scarce and costly, processing cost is quite high. The combustor now developed utilises paddy husk as the source of energy, consumption being 175 kg of husk per hour for combustor output of 600 cfm at 105°C. The first experimental unit installed at the Durgapur unit of FCI has given satisfactory results.

On the basis of recommendation of CMRS, extraction of a seam has been done underneath a main railway line with stowing and another seam is being extracted at the Sudamdih Project of Bharat Coking Coal Limited. The railway line has been allowed to subside by about 38 cm without disruption in its operation.

Advice was rendered by CMRS, to the authorities of the Eastern Coalfields Limited for partial extraction of a seam underneath the railway acquired land by board and pillar system with hydraulic sand stowing at Salanpur Colliery. It would enable the extraction of one million tonnes of coal.

Expertise was also extended for the introduction of longwall system of mining with caving in three mines of Eastern Coalfields Limited, one mine of Bharat Coking Coal Limited, three mines of Western Coalfields Limited and one mine of Central Coalfields Limited with a view to reducing the cost and increasing the rate of production.

Continuous monitoring of surface movement by CMRS has enabled extraction of about 1.4 million tonnes of coal from 12 panels under highest flood level of Surakachar Colliery of Western Coalfields Limited by longwall system with hydraulic sand stowing.

RRL, Jammu, has supplied to the J&K State Minerals Corporation design and drawings for a commercial borax plant being set up in Ladakh.

Hindustan Antibiotics Ltd., Pimpri, Pune, are installing a plant for the production of 6 APA (amino-penicillic acid), using an immobilized enzyme catalyst developed at NCL. NCL is advising the company regarding the design of a plant of 35 tonnes per annum (tpa) capacity.

Reports have been submitted by NEERI on: assessment of silver losses from the stack of M/s Hindustan Photo Films Mfg. Co. Ltd., air quality survey to assess the implementation for locating a petrochemical plant in the vicinity of coke calcination plant sponsored by M/s Bongaigaon Refinery and Petrochemicals Ltd., Bongaigaon; and air pollution survey of Chembur-Trombay area, Bombay, sponsored by the Maharashtra Prevention of Water Pollution Board.

Based on the recommendations made by NEERI as a result of inplant surveys and waste treatment studies, the Rourkela Steel Plant Authority have implemented a few pollution control measures resulting in improvement of plant environment.

Hindustan Aeronautics Ltd., Koraput Division, was assisted in starting production of the special enamels developed earlier by CGCRI for the exhaust system of jet aero-engines against corrosive action of high temperature gases.

At the request of the Gujarat State Housing Board, Ahmedabad, SERC furnished designs and drawings for setting up of a factory for producing pre-cast building components required for the construction of 1,000 houses per annum.

A set of 22 magnetrons developed and batch produced at CEERI for the Indian Navy was handed over to the user in May, 1978. This marked the completion of the supply of a total number of 75 magnetrons to the Indian Navy. Technology for production of 500 kW magnetrons was also transferred to M/s Central Electronics Ltd.

NPL has set up a facility for the production of monochrome TV phosphors on pilot plant scale and has supplied phosphors to Bharat Electronics Ltd., Bangalore for the acceptability.

Sea water magnesia technology developed by CSMCRI was evaluated by a consulting engineering firm for the Steel Authority of India Limited, who have

shown interest. Andhra Pradesh Industrial Development Corporation also evinced interest in this technology and the matter is being processed. The Steel Authority of India Limited intends to go on to large scale manufacture of sea water magnesia for catering to the requirements of magnesia refractories used in steel mills.

Surface Coatings

A formulation of strippable alkali-resistant chemical milling coating and another formulation of a paint remover, specially used for epoxy coatings on aluminium alloy substrates, were developed by RRL(H) for the Hindustan Aeronautics Limited, Nasik.

Spraylat, a temporary protective coating for polymethyl methacrylate sheet was developed by RRL (H) for Hindustan Aeronautics Ltd.

An anticorrosive strippable coating developed by RRL (H) for protection of metal structures was used and approved by Bharat Heavy Electricals Ltd., Hyderabad.

Melting of non-magnetic stainless steel and chemical analysis of the steel were done by CSIO for Bharat Heavy Electricals Ltd., Hardwar. On-job training in the manufacture of aspheric condenser lenses was imparted to two technologists from the National Instruments Ltd., Calcutta.

Detailed evaluation studies were carried out by CGCRI on kyanites occurring in Bhandra district of Maharashtra for the Maharashtra State Mining Corporation Ltd., Nagpur, which indicated that the minerals were suitable for making high alumina refractories.

A two tonne per hour capacity steam generating fluidised bed combustion boiler using the high sulphur Assam coals has been erected and commissioned at RRL, Jorhat. This is a collaborative project with Bharat Heavy Electricals.

Airborne geophysical surveys were carried out by NGRI in Eastern Brahmaputra Valley and Manandi Basin for Oil India Limited. The total area covered by this survey has been about 41,000 sq. km. and a total of about 25,000 line-km have been flown. The data are being interpreted.

NIO undertook several projects sponsored by public sector undertakings. The beneficiaries were: the Oil and Natural Gas Commission, the port trusts, Central Board for Prevention and Control of Water Pollution and Travancore Titanium Products Ltd., The Areas of work related to pipeline surveys, pollution control, location of lost oil well-heads and shore protection.

TRA helped Assam Tea Corporation, West Bengal Tea Development Corporation and Tea Trading Corporation of India for increasing the productivity of their tea gardens in terms of yield and quality of tea.

Heat absorbing glass filter required in the manufacture of slide and film projectors and hitherto imported, has been developed by CGCRI. Samples have been sent to Central Electronics Ltd. for evaluation.

The Service and Maintenance Centres of CSIO, located in different parts of the country repaired about 1900 instruments valued at approximately Rs. 170 lakhs and earned around Rs. 6.7 lakhs. Among several medical, educational, industrial and government institutions and many public sectors organisations served are the following: Bharat Heavy Electricals Ltd., Hardwar; Modern Bakeries, New Delhi; ECIL, Lucknow, Haryana State Electricity Board; U.P. State Electricity Board; H.P. State Electricity Board; Punjab State Electricity Board; and Guru Nanak Dev Thermal Plant, Bhatinda. Repair and maintenance service of instruments was also provided to Directorate of Health and Family Welfare, Pondicherry, Deptt. of Highways, Madras; Telephones, Hyderabad, All India Radio, New Delhi, Electricity Department, Chandigarh, Posts & Telegraphs Department, Chandigarh, Public Works Department, Chandigarh, Panchkula and Rohtak; Forest Department, Simla; and Directorate of Health Services, Jammu.

LARGE AND MEDIUM SCALE INDUSTRIES

RRL(H) has supplied the technological know-how and detailed designs and has also assisted Messrs MCA Chemicals Ltd., Patancheru, Andhra Pradesh, in the erection and commissioning of a commerical plant to produce 450 tpa monochloroacetic acid (MCA). MCA is an important intermediate for the manufacture of textile chemicals, drugs, dyes and farm chemicals.

M/s Electro Chem. Enterprises, New Delhi, have commenced production of potassium silicate based on the process developed by RRL, Jorhat. The plant, first of its kind in India, has an installed capacity of 50 tonnes per annum. Electronic grade potassium silicate solution finds extensive application in manufacture of television tubes and screens, cathode ray tubes, etc.

M/s Kutch Cement Pvt. Ltd., Bhuj, Gujarat have erected a 30 tonnes per day capacity vertical shaft kiln for cement manufacture based on the know-how developed by RRL, Jorhat. The Laboratory has also provided detailed design and lay-out of the plant. A 2 tpd pilot plant has already been successfully commissioned at site for evaluation of locally available raw materials and working out a suitable raw meal composition for the 30 tpd kiln.

M/s Hico Products Pvt. Ltd., Bombay and M/s Dal-Ichikarkaria, Pune obtained licences for commercialisation of the process on oil well cement additive developed by RRL, Jorhat. M/s Hico Products Pvt. Ltd., commenced manufacture of the additive and supplied it to Oil India Ltd., Duliajan. The Oil & Natural Gas Commission (ONGC), both in the eastern and western sectors, including for offshore drilling, is currently meeting its cement additive requirement through import.

Thionyl chloride is an important intermediate for pesticides, NCL had developed a process for thionyl chloride in collaboration with Dharmsi Morarjee Chemical Co. Ltd., Ambernath and the firm has started production on

pilot plant scale based on the NCL know-how. The firm has been licensed to produce 1500 tpa of thionyl chloride.

Dimethylaniline (DMA) is an important intermediate used in the dyestuff industry and also in the manufacture of defence chemical - tetryl.

M/s Sahyadri Dyestuffs and Chemicals, Pune, have successfully established commerical production of dimethyl aniline (DMA) at their Dewas



A view of the 3600 TPA continuous dimethylaniline plant at Dewas (MP) put up by M/s Sahyadri Dyestuffs and Chemicals, Poona based on a novel technology developed at the National Chemical Laboratory, Poona on sponsored basis

and industries. Ten PTCs, on each at Ahmedabad, Bangalore, Bhopal, Bombay, Calcutta, Hyderabad, Lucknow, Patna, Shillong and Trivandrum are functioning. These PTCs are engaged primarily in the identification of technological problems of the industries in the area, arranging for their appropriate solution through CSIR laboratories and other R&D institutions and acquainting the laboratories with the scientific and technological needs of the industry. Based on the success of the PTCs, the Governing Body of the CSIR has approved of PTCs as a regular activity of CSIR.

The Division for Scientific and Technical Personnel (DSTP) carried out various studies relating to the availability and utilisation of highly qualified Indian scientific and technical personnel in the country and abroad, thus acting as the clearing house of information on scientific and technical manpower.

The Division has published a comprehensive study on Post-Graduate Scientists in India, based on the 1971 Census of Degree Holders and Technical Personnel, and other primary data. Study of the Contribution of Professional Societies to the Training of Graduate level Engineers and Technologists, a detailed study of Graduate Nurses in the country, two studies on Indian Students and Trainees Abroad and another on Foreign Students in India, have been completed. Data on Post-graduate specialisation of engineers and technologists have been compiled. Reports on Graduate Engineers, Medical Personnel, Women Scientists, Scientific and Technical Personnel for R&D in CSIR laboratories, and contribution of the Scientists' Pool are under preparation.

A computerised Specialists' Register with about 25,000 records has been organised, and recommendations of appropriate personnel were made for about 300 jobs during the year.

Temporary placements in the Scientists' Pool were offered to 675 persons, selected in consultation with UPSC, bringing the total so far to 13,318.

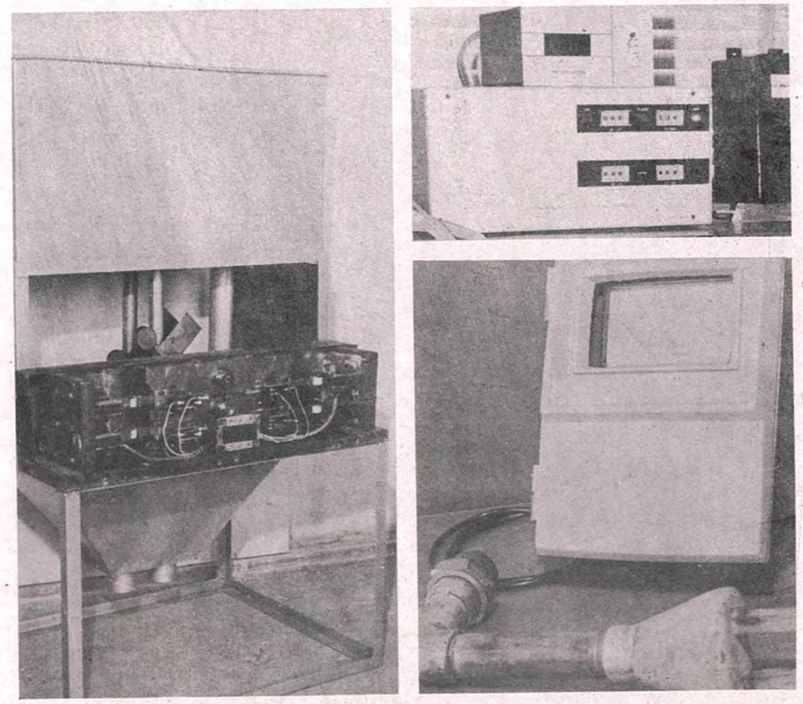
The Division brought out eight issues of 'TECHNICAL MANPOWER', six issues of Indians Abroad Directories containing particulars of Indian scientists and technical personnel who had been abroad, and eight Pool Supplements containing particulars of persons selected to the Scientists' Pool.

CSSTD continued to undertake studies in areas relating to science, technology and society interface. The following studies were completed (and publications brought out):

1. Role and Pattern of Communication in R&D.
2. R&D planning in the Framework of National Plans.
3. Alternative Technology (proceedings of a seminar in collaboration with the Indian Institute of Advanced Studies, Simla).
4. Science Policy Studies carried out in industrialised countries and by International Institutions on Developing countries.

A major achievement of CEERI has been the designing, development and fabrication of the electronic process control instrumentation for the automatic *p*H monitoring and pan boiling stages of the sugar industry. Prototypes of *p*H monitoring unit and Panometer were tested for satisfactory performance at Oudh Sugar Mills, Sitapur (U.P.) and Simbhapali Sugar Mills Ltd., Ghaziabad (U.P.) during actual production.

A large number of bench and pilot plant projects on mineral beneficiation have been conducted by NML on behalf of private and public sector organisations. These relate to beneficiation of complex Cu-Pb-Zn ores; beneficiation and sintering of Bailadila iron ore samples of deposit 4 & 5; sintering of Baraua iron are fines; beneficiation of pyrites, beneficiation of low grade kyanite, beneficiation of middling of Gidi Coal washery, etc. All these projects have been undertaken on behalf of public and private sector organisations like Wishakapatnam steel plant; Pyrites, Phosphates and Chemicals Ltd., Dempo Mining Corporation, Hindustan Zinc Ltd., Hindustan Copper Ltd., SAIL, Rourkela, Central Coal fields Ltd., Indian Iron and Steel Co., etc.



Electronic process control instrumentation for sugar industry, CEERI

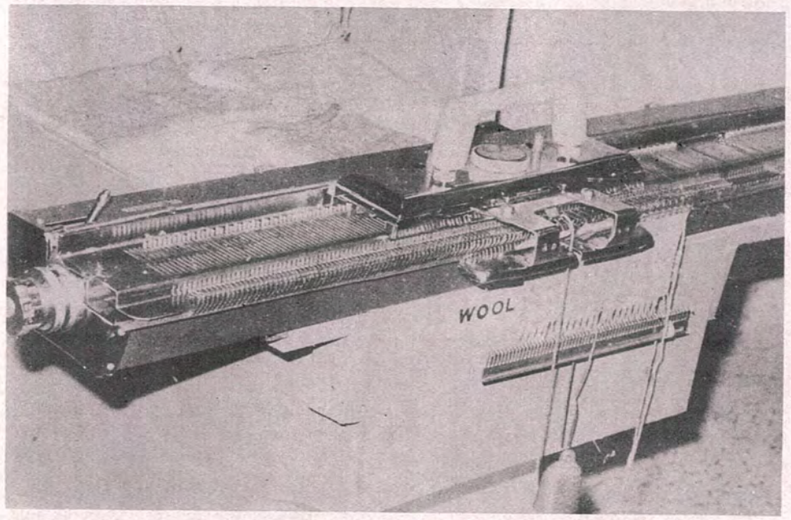
SMALL SCALE INDUSTRIES

The Mechanical Engineering Research and Development Organisation (MERADO) Centre of CMERI at Ludhiana has designed and developed a semi-automatic hand wool knitting machine which can knit self and multi-colour designs in plain, tuck and slip stitches to make garments wide enough to fit 140 cm chest/hip. A local firm has already marketed this machine at Rs 1800 per unit.

NCL has developed the know-how for silver paste for mica capacitor electrodes. The process was released and demonstrated to the representatives of (a) M/s Ramans (India), Ambala city and (b) M/s Jyoti Refineries, Nagpur. Mica capacitors find wide use in electronic circuits for radio, television, etc. M/s Varsal Chemicals P. Ltd., Bangalore have acquired the NCL technology for ethephone, a plant growth regulator used in rubber plantations and on fruit plants.

Based on the know-how developed by CECRI, Somsons Enterprises, Bangalore, Rustum Industries, Calicut, Import (Asiatic) Co., Madras have commenced production of rust converter. This is used to convert rust on steel surfaces into a protective coating thus acting as a good base for painting and increase of paint life. The rust converter composition can be applied by brush on erected structures.

Southind Flash (P) Ltd., Aroor, Kerala, have commenced trial production of Leclanche dry cells based on CECRI know-how. This process utilise indigenous manganese ore as depolarizer.



Wool knitting machine developed by MERADO, Ludhiana

HONOURS AND AWARDS

16. Dr. N.D. Ghatge, NCL, Pune, has been awarded (along with Shri B. Banerjee of the Indian Rubber Manufacturers' Association) the first Dunlop Award (1978) of the Dunlop India Limited.
17. Dr. H.V.K. Udupa, CECRI, Karaikudi, has, on invitation, worked as a Visiting Professor at the Tokyo Institute of Technology, Japan.
18. Dr. Asghar Husain, RRL, Hyderabad, has, on invitation, worked as a Visiting Professor of the Department of Chemical Engineering, McMaster University, Hamilton, Canada.
19. Dr. O.K. Koul, RRL, Jammu, has been awarded the Young Scientist Award of the Indian Science Academy.
20. Dr. D.C. Goswami, PID, New Delhi, has been awarded a prize in the XXI National Prize Competition for Children's Literature organized by the National Council of Educational Research and Training.
21. Dr. V. Jagannathan, NCL, Pune, has been awarded the VASVIK (Vividhlaxi Audyogik Samshodhan Vikas Kendra, Bombay) award for the year 1978.
22. Prof. V.A. Altekar, Director, NML, Jamshedpur, has been awarded the Distinguish Achievement Medal of the Colorado School of Mines, USA.
23. Prof. A. Rahman, Chief (Planning) and Head, Centre for the Study of Science, Technology and Development, CSIR, has been elected President of the International Council for Science Policy Studies (ICSPS).

BENEFITS TO INDUSTRY

A new dental restorative material-quartz in a polymer has been developed at RRL, Trivandrum. This material is presently being evaluated in Sri Chitra Medical Centre and it is expected to be a suitable substitute for very expensive imported material.

In an effort to modernise the conventional handloom, CMERI has designed a pedal loom ensuring higher output and quality finish of woven cloth. Hand operation has been completely eliminated. The feet drive a shaft cam mechanism to activate the up and down movement of thread channels, drive the shuttle with sleigh, and to operate rolling and restrict shrinkage of rolled cloth with two rollers at punch points (loom size-52", picks per minute-120, output-25-30 metres/day of 8 working hours).

For catering to the needs of beverage sellers, hotels, restaurants, laboratories, hospitals, universities, etc. a tip ice machine has been developed by CMERI. The machine is compact in size and requires only 220 V 15 amp. electrical supply and proper water supply connection. Ice is produced in about one hour from the starting and subsequent batches are produced within 20-25 minutes.

CFTRI released eighteen processes to 35 parties; of these, 12 were through NRDC. The process for tamarind powder was developed and released to industry. The commissioning of plant and process demonstration were carried out for a Mysore firm manufacturing spice oils and oleoresins.

A health and environmental survey of 500 agate stone cutters at Khambat (Gujarat) undertaken by ITRC revealed that tuberculosis was prevalent in more than 25 per cent and silicosis in 10-15 per cent of workers. During the grinding operations agate dust is profusely generated in the work atmosphere and inhaled by women and minor children engaged in the profession.

Herbal Chemicals, Denis Gate, Jammu have utilised the technology of producing Xanthotoxin from the roots of *Heracleum candicans*. This technology developed by RRL, Jammu has been released to six parties so far. Xanthotoxin is used as a medicine for leucoderma.

The extension centres of NML at Ahmedabad, Batala, Howrah and Madras are being increasingly utilised by small scale industries for whom special concessional rates are being offered. Small foundries in these locations are making use of the scientific and technological quality control facilities available in these extension centres.

RURAL DEVELOPMENT

Although CSIR was not originally geared to problems of rural development, it accepted the challenge by contributing to the utilisation of raw materials available in rural areas, upgrading of skills of artisans and creating industries on the basis of resources and skills in rural areas. A number of very specific problems were undertaken for utilisation of materials hitherto not utilised, production of specific implements which could facilitate work and improve productivity in rural areas and creation of better environment and living conditions. Problems were also taken up for utilisation of newer capabilities and cultivation of commerically profitable plants and their utilisation for production of chemicals and other materials.

The improved sun drying procedure for paddy and its beneficial effects in improving milling quality have been demonstrated by CFTRI in two villages of Mysore district. The low shedding strain of Madhu paddy developed by the Institute has been distributed for further cultivation.

A recirculating drier (capacity, 500 kg/hour) for the drying of monsoon paddy, which is a major problem in Karnataka and Tamil Nadu, has been designed and fabrication is in progress.

A technique has been developed for village level cultivation of mushrooms, and the process worked out for formulation and drying of cocoa beans has been demonstrated at three cultivation centres in Kerala to enable better returns to growers. Two leaf cup machines developed and fabricated by the Institute have been successfully tested at the Arecanut. Processing and Sales Cooperative Society, Sagar, Karnataka and 50 units are expected to be fabricated by this organisation.

The efficiency of a chemical emulsion developed by CFTRI for quick and uniform drying of chillies has been established for varieties grown by the Andhra Pradesh Agricultural University to help growers in the region get better returns.

Traditional techniques for paddy-cum-prawn culture in Kerala have been further improved by NIO. Using the new technique, the yield of the choicest variety of prawns could be raised to as high as 800-1000 kg/ha against 650-700 kg/ha by the old (traditional) method. Efforts are being made to popularise the new technique.

Sponsored surveys were continued to be carried out by NGRI for ground water and bed-rock investigations in Andhra Pradesh. Acquifier tests were carried out in the Lower Maner Basin to delineate the vertical and lateral extent of the acquifiers. Fourteen tubewells were logged geophysically in the Vedavati River Basin to delineate the water bearing horizons and their thickness, water quality, stratigraphic correlation and sequence. This work was sponsored by Vedavati River Basin project Authority.

After the successful installation by CSMCRI of a solar still plant of capacity 5,000 litres per day in the village Awania near Bhavnagar, construction was

undertaken for two similar plants one each at Narayan Sarovar and Churu district. When on stream these plants will meet the requirement of potable water of the people of these places.

NEERI is assisting the States of Andhra Pradesh, Haryana, Maharashtra and Tamil Nadu in the construction of water treatment demonstration plants in rural areas which employ the slow sand filter techniques.

The first demonstration plant was commissioned in India at Abubshehar, a group of villages in Sirsa district of Haryana in November 1978 at a cost of Rs. 16.68 lakhs for a population of 13,000. The second demonstration plant was commissioned at Kamayagoundanpatti village near Madurai on March 15, 1979. It was constructed by the Tamil Nadu Water Supply and Drainage Board at a cost of Rs. 4.11 lakhs. The plant has augmented the drinking water supply to the village by one lakh gallons per day.

The advantages of slow sand filters are simplicity in operation and maintenance and reliability of the filtered water quality. No skilled supervision is necessary.

RRL(Jorhat) has developed a new technique for bamboocrete low cost house. Bamboo and timber constitute most versatile building materials for low cost housing. In this technique pre-treated split bamboos of specific size in pairs are put in the form of an arc and another set of split bamboos are put at right angles making a cross weaving. This forms the bamboo structure in the form of a shell for the roof. Then two coats of cement plaster are given. The roof is supported at ends and middle by bamboocrete diaphragm walls. A two room house including services for a plinth area of 33 sq. m costs only Rs. 5,500/-. The Housing and Urban Development Corporation Ltd., New Delhi is offering financial assistance through State agencies for construction of houses using this bamboocrete housing technique.

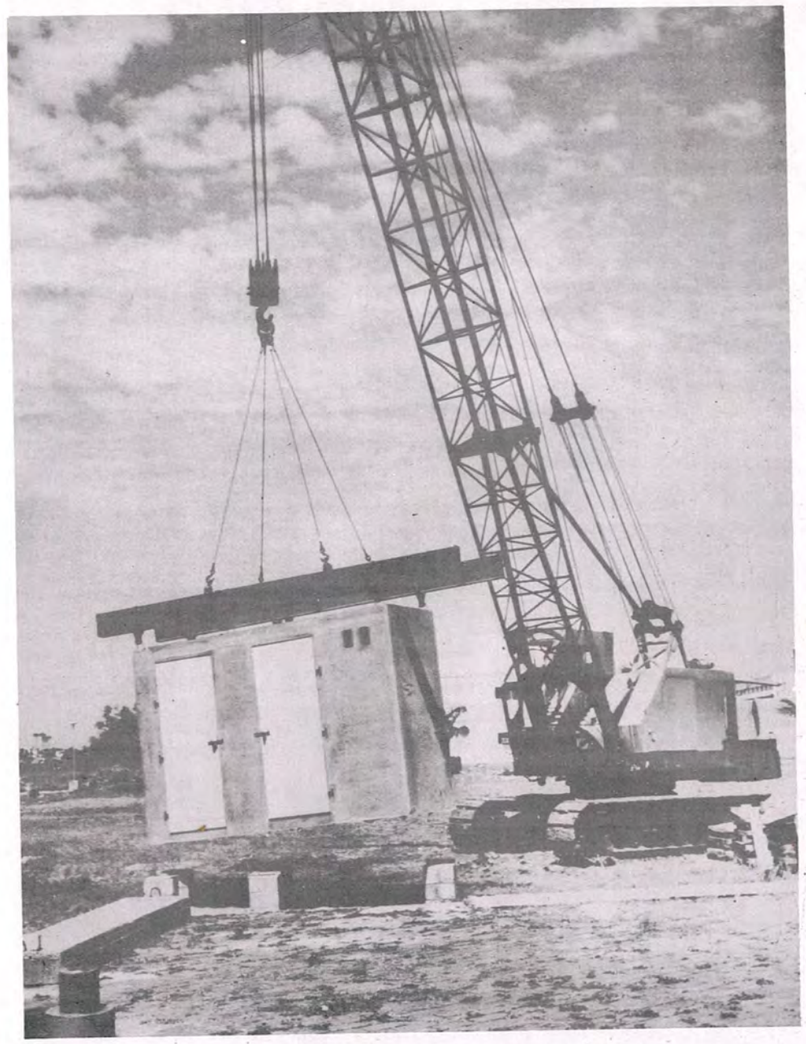
SERC, Madras has developed 3-dimensional ferrocement service core units for use in the Sites and Services scheme of the Tamil Nadu Government for the benefit of the low income groups. The ferrocement units, developed by SERC, will significantly reduce the construction cost of service core units. Ferrocement is a highly versatile form of reinforced concrete made of cement mortar and wire mesh which possesses unique qualities of strength and serviceability. Ferrocement structures can be built with a minimum of unskilled supervised labour and utilises readily available materials.

The State Housing Board is now constructing 80 service core units at Villivakkam, near Madras. A saving of 10 to 16 per cent in cost and 30 per cent in cement can be achieved by using ferrocement as compared to conventional construction with brick masonry walls and RCC slabs. Also, as much as six per cent incrased floor area can be obtained due to thinner walls.

A set of four bath-rooms and four W.C. with an overall size of 6 m× 1.90 m can be constructed in six days by three masons at a cost of Rs. 2,600 (excluding

the cost of service fixtures). The cost of one bath and one W.C. works out to Rs. 670 while the service fixtures would cost another Rs. 130.

RRL(Jorhat) initiated its activities at Senua, a tribal village of Tirap district of Arunachal Pradesh by bringing five acres of land under commercial cultivation of *Solanum khasianum* through the involvement of 24 tribal families. The necessary financial input was forthcoming from the Arunachal Pradesh



Ferrocement service core units developed by SERC, Madras

Administration. This successful cultivation of *Solanum khasianum* encouraged the tribal families to take up commercial cultivation of other medicinal plants such as *Java citronella* and Lemon grass and as a result, 62 acres were brought under cultivation. The Deptt. of Agriculture, Arunachal Pradesh installed a 400 kg. distillation still with the technical advice of RRL(Jorhat).

Agrotechnologies developed by CIMAP for some of the important medicinal and aromatif Olants were transferred to interested parties. Some of the processes were also utilised in the Institute itself. As a result of such efforts the country saved Rs 8.25 crores and earned Rs 60 lakhs of foreign exchange. Major items of production were 350 tonnes of Japanese mint oil valued at Rs 3.5 crores, 250 tonnes of citronella oil (Java) valued at Rs 2.25 crores and 50 tonnes linaloe oil valued at Rs 1 crore. Other important items were peppermint oil, spearmint oil, geranium oil, *Catharanthus roseus* leaves and roots, davana, ergot, belladonna, diosgenin, pyrethrum oleoresin, etc.

RRL(Bhu) has made efforts to popularise the cultivation of palmarosa grass in the Mayurbhanj district and cinnamon in the coastal district of Balasore and Ganjam, besides giving technical help to a large number of parties. A hydro distillation unit for the extraction of essential oils under field conditions has been designed, developed and fabricated in the laboratory. The know-how has been released to a number of parties through NRDC.

One quintal of seed of Winged Bean *(Psophocarous tegragonolobus)* a highly proteinaceous legume, all parts of which are edible, together with extension literature in Hindi on its cultivation, was released by NBRI to the Government of U.P. for distribution among the villagers at the block level, after it had been successfully introduced and tried for its suitability for large-scale cultivation in North India.

OTHER PROJECTS FOR RURAL DEVELOPMENT

A field scale nightsoil digester is in operation in Central Prison, Nagpur as a research-cum-demonstration plant for biogas production put up by NEERI.

Appropriate technologies developed by CLRI are: (i) Process for bag tanned leather and shrunken grain buffalo calf skin; and (ii) Polyvinyl chloride/polyvinyl acetate co-polymer based finishes for rural vegetable tanned leathers.

Two strawboard units of one tonne per day each have been established in Karimnagar district, Andhra Pradesh and have gone into production. Another handmade paper plant (250 kg/day capacity) has been set up in Karimnagar for making speciality papers and is in trial production. These are based on the processes developed by RRL(H).

Raw glaze compositions including coloured glasses developed at CGCRI showed promising results on trial firing using wood fuel by the Jamunalal Bajaj Central Research Institute, Wardha, the maturing temperature being in the

range of 1130°-1150°C. Work is in progress to further lower the maturing temperature. Local clays occurring near Wardha were evaluated and found suitable for making glazed stoneware pipes as well as kitchenwares.

Low-cost ceramic glazed wares maturing at lower temperatures were developed at CGCRI using two red clays supplied by the Palli Sangathan Vibhag, Viswa Bharati, Shantiniketan. Investigations are underway for making single-fired stoneware pipes and unglazed vitreous tiles using these clays.

Work on rural communication system was started by CEERI and point to point communication systems using CEERI trans-receivers were set up in two villages near Pilani. Some active antennas for CEERI trans-receiver units were also developed.

Under rural development programme, training of rural youth in the servicing and assembly of radio receivers and a village wireless communication experiment were initiated by CEERI.

CSIO conducted a 3-day Seminar on 'Technology for Rural Health Care'. It was attended by 35 delegates among whom were eminent doctors, rural development specialists, technologists involved in medical instrumentation and industrialists. The doctors represented primary health centres, medical hospitals, institutions and health departments of States. This Seminar has resulted in identification of instrumentation requirements for rural health care.

A centre for application of science and technology for rural development has started functioning at NCL.

The Management Development Unit of the Planning Division, CSIR organised a workshop 'Gaon-ke Karigar Aur Science' (Village artisans and science) at Sevagram, Wardha and followed it up with a two-day get-together of scientists and discussions with the Prime Minister (for details, please see section 'Headquarters Activities').

COLLABORATION WITH MINISTRIES/DEPARTMENTS

The full range of collaboration of CSIR with various ministries/departments at the Centre as well as the States would be evident from the number of scientific and technical representatives of the Government who have been involved at various laboratories in the decision making system of CSIR dealing with research projects, polytechnology centres, liaison, extension and other advisory committees. Scientists and technologists from the laboratories have also been associated with the development projects initiated by the various States/Centre at various levels. A number of projects had been undertaken by CSIR laboratories in collaboration with different ministries/departments of the Government of India and State Governments. A brief account of the progress of these projects is given below.

NAL participated in the design studies and wind tunnel testing of the HF-25 aircraft in response to the Air Force specifications for a tactical air support aircraft. The laboratory also developed technology to supply titanium powders to the Defence Metallurgical Research Laboratory, Hyderabad on a joint project for developing the technology of powder metallurgy for fabricating precision components for aeronautics.

A FRP radome for Fairchild packet aircraft has been designed and developed by NAL at the request of the Air Headquarters. This specially built radome consists of a solid wall of 1.5 mm thickness with radial stiffeners. The shape of this radome is almost like a spherical cap. The radome was fitted to one of the aircraft for test flight. Efforts are now under way to improve and batch produce.

A requirement was received by NPL from the Space Application Centre, Ahmedabad, for neutral density filters (in six different densities) on quartz substrates to be used in the Indian satellite. The work was undertaken on priority basis, and 24 filters were supplied. The filters were used in the Indian satellite 'Bhaskara'.

An electronic digital clock with ambient temperature display was fabricated by NPL for the Indian Agricultural Research Institute, New Delhi. The clock consists of a 7 segment ordinary bulb display, displaying time and temperature one after the other, and can be viewed from a distance.

CFTRI has assisted the Ministry of Agriculture through analysis of 17,848 samples of fruit and vegetable products under the Fruit Products Order and foreign buyers' specifications. The Central Food Laboratory started functioning at the Institute in April, 1978. About 638 food samples received by courts, customs and port health offices have been analysed under the Prevention of Food Adulteration Act.

SERC, Madras assisted the Bharat Heavy Electricals Ltd. Tiruchirapalli, by undertaking a critical review of the designs made for a number of buildings on the project site and suggesting improvements/modifications in them wherever found necessary. The Centre, at the request of the Department of Lighthouses

and Lightships, Ministry of Shipping and Transport, New Delhi, also prepared proposals for the design of light beacons using precast modular construction techniques. It also collaborated with the Ministry of Works and Housing in the preparation of a report on Prefabrication and Modular Coordination in Building.

Aeromagnetic surveys covering about 40,000 line-km along Narmada-Sone Lineament were carried out by NGRI under sponsorship of the Geological Survey of India.

In order to help semi-automatic extraction of the fibre, CMERI has developed a pineapple decorticator (capacity 6-10 mg fibre/hr) on the request of the Government of West Bengal. The development will lead to employment generation in rural areas.

TRA assisted the Governments of Nagaland and Meghalaya for assessing techno-economic feasibility of tea plantation in their States, in close collaboration with the Tea Board.

Detailed evaluation work on china clays occurring in Purulia and Bankura districts of West Bengal was carried out by CGCRI for the West Bengal Directorate of Mines and Minerals, with a view to utilising the promising deposits for setting up ceramic units in the State.

A cone shaped device incorporating a suitable sclerosing agent for blocking the uterotubal junction in women, and which could be used for control of fertility, has been developed by CDRI in collaboration with the Army Hospital, New Delhi.

A study of health hazards of sixty welders drawn from three welding units in Bombay was conducted by ITRC in collaboration with the Central Labour Institute, Bombay to assess the exposure to manganese fumes during welding operations. It was found that concentration of manganese higher than the recommended level was present in all the three plants.

U.P. Directorate of Health Services has placed outdoor occupational health clinic facilities at the disposal of ITRC in a hospital attached to the Employees' State Insurance Scheme at Kanpur. This clinic started functioning in an exploratory manner in August, 1978. 248 Suspected cases of occupational disease of a diverse variety referred to by the industries in Kanpur were examined at this clinic. As the reference laboratory of the U.P. Government, the Centre analysed 30 samples of effluents for and on behalf of the Uttar Pradesh Water Pollution (Prevention and Control) Board.

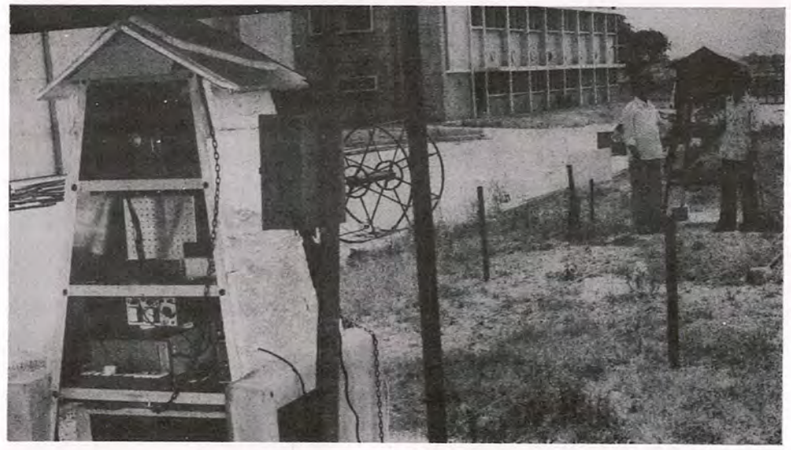
INSTRUMENTATION

Instrumentation has now become a major industry both with regard to research and development as well as the production system. CSIR has worked out different systems of instrumentation required by industries, the medical profession and have also trained expert technicians for specific purposes. Large scale instrumentation facilities and electronic control systems in public sector industries, large and medium scale industries are being periodically serviced and maintained by CSIR centres in different parts of the country.

The technical know-how of digital *p*H meter, digital tachometer, digital optical density meter (electronic unit) echoencephaloscope and foetus stethoscope have been released to industry by CSIO for commercial exploitation. An engineered prototype of monitor DC defibrillator has successfully undergone evaluation and clinical trials and is ready for commercial exploitation.

A sum of Rs. 2.5 lakhs has been earned by CSIO as charges for extending diverse technical assistance to public sector, educational, industrial and other Govt. organisations during the year under review. Some specialised jobs executed include fabrication of 310 sets of dumpy level optics, 35 nos. of parabolic lenses for microfilm reader and 20 nos. of micrometer graticules (window) for the National Instruments Ltd., Calcutta.

The measurement of visibility is an important and continuing problem at civil and military airfields. For flying operations, a quick-acting and accurate instrument is required to respond to rapidly changing visibility under foggy conditions. With this in view, an automatic visual range assessor (AVRA) system has been designed and developed by NAL. The system developed has an advantage over the conventional Skopograph now being used in many Indian



Automatic Visual Range Assessor (AVRA) system developed by NAL

airports, in that AVRA measures more accurately attenuation, background luminance and runway light intensity.

CMERI has also developed an instrument for measuring the depth of surface cracks. The instrument is capable of measuring crack depths upto 15 mm in three ranges with an accuracy of ± 3 per cent. This instrument will be useful for non-destructive examination of surface cracks on electrically conducting work pieces.

A diffusion type portable methanometer was designed and developed at CMRS for the detection and estimation of methane in coal mines. The know-how was released to M/s Rayrolle Burn Limited, Calcutta.

A dust extractor has been designed and developed by CMRS for collection and disposal of dust particles produced during drilling short holes for blasting. The know-how of the design has been released to M/s Techno Engineers and M/s Kalyan Engineering Works, Dhanbad for commercial exploitation.

A multi-point system for continuous telemonitoring methane concentration simultaneously from several strategic underground locations £ developed by CMRS in collaboration with M/s Bharat Bijlee Limited, Bombay. The system helps control explosions in coal mines.

A workshop for the production of sophisticated prototype geophysical instruments was commissioned at NGRI under a UNDP assisted project. Portable proton magnetometer (direct reading type) has been designed and fabricated. A borehole stress meter capable of monitoring induced stresses up to 8,000 psi has been fabricated at the Institute to help study the rockburst phenomena in mines.

CSIO continued its activities in training by conducting diversified programmes at its Indo-Swiss Training Centre at Chandigarh and providing the industry with well-trained junior technologists. This year the centre has produced 73 technologists with diploma in instrument technology, 10 with post-diploma in industrial electronics and 16 with post-diploma in die and mould making.

Three types of anchorage pulling device were designed by CMRS to test installed ropes for roof support periodically for the effectiveness of grouting and bamboo bolts to be used as support. A pre-tension grouted bolt was developed to support the roof mines immediately where the strata condition is difficult. A grouting hopper was designed to fill the drill holes pneumatically where cement grouted bolts are used to support roof. All the designs were released on sponsored basis to M/s Progressive Machine Tools of Jaunpur.

Three geological equipment (1) Piston gravity corer, (2) Deep sea grab, and (3) Fluorescent tracer release drum were designed and fabricated by NIO. Besides them, marine thermometer, flashlight control for buoys, underwater copper resistance thermometer, CTDs system and Wave-sled for beach-profile work were fabricated and tested successfully.

NATIONAL FACILITIES

The national laboratories of CSIR have developed specialised facilities which are unique in the country and utilised by a number of agencies. The existence of these facilities adds distinctively to the scientific and technological potential of the country as a whole.

The 1-2 m Wind Tunnel of NAL continued to be a major national facility of its kind and undertook tests for outside organisations as well as for the in-house projects. During the year, a total number of 607 blowdowns were conducted, thus totalling the overall number of blowdowns conducted, so far to 7741. Major test programmes executed for external organisations include flutter tests on SLV-S fin, external stores studies, effect of addition of strakes and the surface oil flow visualisation studies on aircraft models.

The laboratory has established a versatile experimental facility 'Turbomachinery and Combustion Laboratory' as a joint venture between UNDP and Government of India, for undertaking systematic applied research and development work on components of various types of turbomachinery. This is the only facility in India and one of the few in the world wherein a number of versatile experimental facilities as well as in-house supporting technology to manufacture and inspect complex turbine/compressor blades are available under one roof.

ITRC established the Central Facility for Safety Evaluation of Industrial Chemicals and Pesticides. The objective of this Facility is to develop capabilities for assessing chronic or long-term effects caused by toxic industrial chemicals and agrochemicals and the evaluation of newer techniques for monitoring and predicting harmful effects of pesticides on human, animal and plant lives.

The Regional Sophisticated Instruments Centre at CDRI continued to help university laboratories, research organisations and R&D laboratories of the drug industry by carrying out spectra determination (IR, NMR, Mass), gas liquid chromatography, elemental analysis, absorption spectrometry, electron microscopy, etc. of about 1800 samples. The Centre is supported by the Department of Science and Technology (DST).

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DESIGN & CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

The national laboratories of CSIR have developed design and consultancy capabilities in many specialised areas. The laboratories of the physical sciences group (NPL, CEERI, CSIO, NGRI and NIO) have developed design capabilities in optical systems, solar energy utilisation, radio science, communication system, the full range of the field of electronics—solid state devices, vacuum tubes, etc.—geo-physical surveys both air-borne and ground, geo-hydrological studies, marine engineering work and instrumentation process control and monitoring, optical components, analytical instruments, geophysical instruments, marine instruments and electrochemical instruments. They offer consultancy services in these areas and also on pollution control, off-shore oil fields and setting up of manufacturing units.

The laboratories of the chemical sciences group, NCL, RRL (H), CECRI, CSMCRI, RRL, Jorhat have built up design capabilities for a wide range of basic engineering designs for the production of basic organic, inorganic and marine chemicals, dyes, drugs, intermediates, paints, agro-chemicals, pesticides, coal carbonisation and corrosion and electro-metallurgy. NCL and RRL (H) have process design and optimisation cells making use of computer aided design techniques. The laboratories also offer consultancy services in these areas.

The laboratories belonging to the biological sciences group could take up design and consultancy work in the areas of: food processing (CFTRI), phytochemicals (RRL, Jammu), medicinal and aromatic plants (CIMAP and NBRI) and ornamental plants (NBRI). CFTRI offers consultancy facilities on regional resources and industrial surveys both in India and abroad. RRL (Jammu) has also undertaken consultancy services abroad. Industrial toxicology is an area in which ITRC can offer consultancy services.

In the area of glass and leather, CGRI and CLRI respectively can undertake consultancy jobs. They have also design and engineering capabilities developed in these areas.

In the engineering sciences group, complete design and construction of civil engineering structures (turn-key projects both in India and abroad) is an area of expertise in which design and consultancy capabilities have been developed in SERC, Madras. NEERI, Nagpur and CMERI, Durgapur have developed design and consultancy capabilities in the areas of environmental engineering and mechanical engineering respectively. Similarly, in the areas of mining and metallurgy, CMRS and NML have facilities for design and consultancy jobs. NAL is in a position to take up design and consultancy work in the field of aeronautics.

In the field of information sciences, Insdoc can undertake consultancy services in reprography, information technology and computer processing of bibliographic information.

Details of design and consultancy capabilities of national laboratories are given in Appendix IV.

COLLABORATION WITH UNIVERSITIES

From its very inception, CSIR has effectively provided resources to universities by way of fellowships to students for advanced research and grants to research schemes. This has been a major contribution of the organisation. There are also a large number of collaborative programmes with universities in a number of specific areas. The laboratories have undertaken special programmes for the award of degrees in the field of their specialisation. A large number of the staff of laboratories have been recognised as Ph.D. guides by universities and deliver extension lectures.

The number of research fellows as on 1st March 1979 receiving assistance from CSIR was 3900. The total number of research schemes currently in progress is 387.

CFTRI continued to train students from developing countries of West Asia, Africa, South-East Asia and tropical America, at post-graduate level for the M.Sc. degree (Food Technology) of the Mysore University. Besides, three international courses (two on control of environmental contaminants in foods and one on grain milling technology) were organised during the year in addition to ad-hoc training given to representative of various organisations.

The United Nations University (UNU) activities were continued at the Institute for advanced training to eleven follows from different countries of Asia in the area of post-harvest technology.

Several universities were provided repair and maintenance service of instruments by CSIO and its service and maintenance centres in order to minimise the shutdowns due to instrument failure. Some of them are: Osmania University, A.P., Agriculture University, Punjab University, H.P. University, Ghorakpur University and Haryana Agricultural University.

An eighteen-week training course in paint technology was organised at RRL (H) in collaboration with the College of Technology (Osmania University) and the Small Industries Service Institute, Hyderabad.

NEERI is conducting joint projects with the Indian Institute of Technology, Kanpur, the Harcourt Butler Technological Institute, Kanpur and the Administrative Staff College of India, Hyderabad.

In a collaborative programme with the Birla Institute of Technology and Sciences (BITS), Pilani, the Centre for the Study of Science, Technology and Development, CSIR, organised special programmes for the post-graduate students of the Institute in sociology of science and science policy.

In collaboration with the Department of Gynaecology and Obstetrics, K.G. Medical College, Lucknow, a survey of residue levels of chlorinated insecticides was carried out in placental tissues, cord serum and serum of pregnant women by ITRC.

Training in the techniques of toxicological research and safety evaluation of toxic chemicals was imparted by the Centre to staff members belonging to the universities/colleges at Jaipur, Hissar, Muzaffarnagar, Gorakhpur and Nainital.

INTERNATIONAL COLLABORATION

The nature of collaboration with foreign countries was manifold. In addition to collaborative programmes, a number of seminars and symposia were also organised by the laboratories for and on behalf of international organisations. Training programmes were undertaken for the benefit of representatives from foreign countries. Some laboratories acted as input centres for international programmes.

RRL, Jammu undertook fabrication, erection and commissioning of a menthol production plant in Rangoon on behalf of the Government of India under the Indian Economic and Technical Cooperation Programme.

A scientist of CSMCRI, deputed to Bangladesh, assisted a UNIDO project on the establishment of a new salt works in that country.

Under the Government of India's Economic and Technical Cooperation Programme to the Government of Burma, NML in collaboration with the National Research Development Corporation Ltd. of India and a private firm is setting up a pilot plant for the production of 50 kg of electrolytic manganese dioxide per day at the Central Research Organisation (CRO), Rangoon, Burma. CRO has desired further assistance of NML for commissioning this pilot plant.

Under PL-480 scheme, about 300 kg of standard reference samples comprising high carbon and low carbon ferro-manganese and ferro-titanium were forwarded to the National Bureau of Standards, USA. Another proposal has been received for development of a number of other standard reference samples.

A twelve week Regional Training Course on Methods and Techniques in Exploration Geophysics was held at NGRI from November 20, 1976 to February 9, 1979. The course which was sponsored by the Unesco and the Government of India was intended primarily for in-service personnel who are associated with the geological and geophysical exploration programmes for minerals and ground water. Seven foreign participants from Afghanistan, Bangladesh, Egypt, Sri Lanka and Thailand and eight Indian participants from various Central and State Government Departments attended the course.

The second Unesco-sponsored course on science editing was organised by PID during 20-28 November, 1978. PID also organised an exhibition of books, charts and models relevant to the theme of the UNIDO-sponsored forum of Appropriate Industrial Technology organised by the Ministry/Department of Industrial Technology in New Delhi during 20-25 November, 1978.

The services of CFTRI had been made available to the World Bank for establishing a Food Technology Developing Centre in Indonesia.

Active assistance has also been extended by the Institute to FAO in the technical consultation among developing countries for the development of agro-based industries in a conference held at the Institute in 1978. Assistance was also rendered to UNIDO by participation in the preparatory meeting on food processing at Vienna.

CSIO provides practical on-job training to engineers and technologists from various institutions and industries including those of foreign countries. This year training was imparted to a WHO Fellow from the Deptt. of Medical Sciences, Bangkok, Thailand in repair and maintenance of electronic and analytical instruments used for health care in hospitals. British Council had made an arrangement with CSIR for repair and maintenance service of all British equipment received under Colombo Plan aid. Under the arrangement, CSIO and its service centres will provide repair and maintenance services to all such equipment or instruments received anywhere in India by any party under the Colombo Plan.

The construction of slow sand filtration plants is a part of the International research-cum-demonstration project on slow sand filtration initiated by WHO International Reference Centre (WHO IRC) for Community Water Supply, the Hague, Netherlands under its worldwide promotional activities in the field of water supply. In the second phase of the programme, four village demonstration plants were designed and are being implemented as per the guidelines suggested by NEERI. The primary purpose of this project is to demonstrate the suitability and appropriateness of the slow sand filtration process under different local conditions and to promote its large-scale application in India especially in rural areas for the treatment of surface waters.

RRL, Jorhat has been identified as the lead laboratory for planning and coordinating the execution of an inter-country collaborative research and development project for management of water hyacinth.

An agreement has been reached between laboratories, Central Des Industrial Electriques (LCIE), Paris, France and the Electrical Research & Development Association (ERDA), Bombay, regarding technical collaboration for the materials laboratory of ERDA.

In collaboration with the Institute of Fracture and Solid Mechanics, Lehigh University, USA, NAL organised an International Conference on Fracture Mechanics in Engineering Applications at NAL from March 26-30, 1979.

ITRC served as the National Correspondent of International Registry of Potentially Toxic Chemicals set up by the United Nations Environment Programme and collaborated in the network of information system on chemical pollution. Training was given under a WHO programme to two scientists from Bangladesh and Burma.

OTHER ACTIVITIES

A new insecticide provisionally named as 'Indothrin' belonging to the group of synthetic pyrethroids has been synthesised from carene, a cheap and abundant by-product of Indian turpentine oil industry. It is a broad spectrum insecticide with high insect toxicity, low mammalian toxicity and fairly rapid biodegradability. Standardisation of the process conditions of its synthesis in under way and extensive field trials will soon be undertaken. The insecticide is expected to play an important part in public and animal health and in domestic and agricultural pest control.

A controlled release herbicide formulation for the control of parthenium and other dicot weeds has been standardised on pilot plant scale. The process for quinapyramine sulphate/chloride has been developed. This is an important veterinary drug used in the treatment and prevention of trypansomiasis in cattle. Both the above NCL processes have been assigned to NRDC.

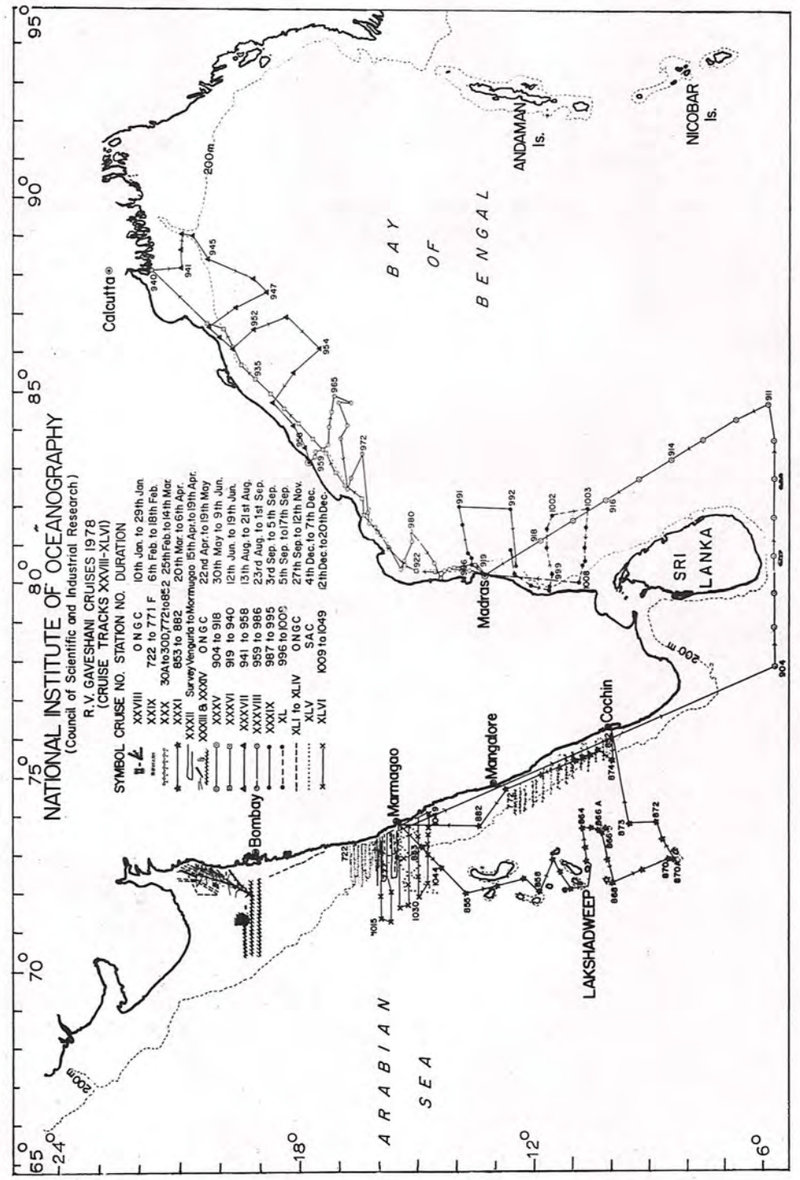
Exploration for offshore ilmenite placers were carried out by NIO in an area of about 105 km² off Konkar Coast and the study revealed that this area is rich in heavy metals upto a depth of about 11 m in the sea bed. The reserves of ilmenite off Ratnagiri have been estimated as 2 million tonnes. Laboratory studies on the samples collected off Kalbadevi, Mirya and Ratnagiri bays have indicated that the heavy mineral placers in these bays extend to about 2 to 5 km offshore and upto a depth of about 9 to 12 m. The heavy minerals in the sediments range from 1 to 91% and ilmenite 1 to 52 per unit.

Studies on the structure of water masses of continental shelf and slope of the West Coast of India, based on the hydrographic data collected on broad R. V. Gaveshani of NIO revealed that the Arabian Sea high salinity water spreads southwards. Low salinity equatorial water (34.2%) intrudes into the south-eastern Arabian Sea at a depth of 200 m. At the surface, a transition zone separating the northern high salinity and low temperature water and the southern low salinity and high temperature water is found between 1° to 16°N latitude.

The Research Vessel Gaveshani of NIO completed 21 cruises covering about 340 stations along 20,000 line kilometres in the Arabian Sea and the Bay of Bengal. The data and information collected during these cruises will greatly enhance our knowledge on the physical and chemical processes, environmental conditions, living and non-living resources of the seas around India.

A seismic surveillance network with three stations at Khonsa (Arunachal Pradesh), Yaongyimsen (Nagaland) and Jorhat (Assam) was established by RRL, Jorhat and NGRI, Hyderabad for generating local earthquake data. Fault plane solutions of some earthquake were determined based on P-wave data.

Different types of ferrous and non-ferrous standard reference materials for accurate spectrographic and chemical analysis were prepared by NML. These were supplied to industries, educational and research organisations,



instrument manufacturers, etc., who are utilising these reference materials in place of the imported products. Already a considerable quantity of these reference materials have been sold to these organisations and more and more demands are received.

An aluminium base sacrificial anode designated as "Superal" has been successfully developed by NML for cathodic protection of ship-hull and other submerged structures. In collaboration with NIO the sea-going vessel Gaveshani of the Institute was fitted with NML anodes. The performance of NML anodes was found to be superior to other types of aluminium anodes. Industrial scale trials have proved the viability of this product from melting and casting to finishing stage. The technology is in the process of being released for commercial exploitation.

The aluminium alloy conductor designated as NML PM 63 has been developed for its applications as overhead conductors for electrical transmission and cable armouring wires.

Aluminium alloy welding filler wire, designated as NML PM 7 for welding/repair of high strength aluminium copper alloys has been developed. The filler wires presently are imported. Ingots were made, processed and wires were drawn to required gauge diameters. Samples have been sent to M/s Hindustan Aeronautics Ltd., Bangalore for evaluation.

The new products developed at CLRI, Madras include (i) syntan-L-a retanning synthetic tanning agent for producing leathers with good light fastness properties, (ii) lacquar-CA, (iii) Collagen sheet for covering burn wounds, (iv) preservative from neem oil (for curing hides and skins), (v) a low cost culture medium compound from wheat bran and green gram extracts for producing enzymes for use in pretreatment of hides and skins, and (vi) sheet materials from vegetable tanned leather waste.

DISSEMINATION OF INFORMATION

PID started the publication of an abstracting bimonthly entitled 'Medicinal and Aromatic Plants Abstracts' (MAPA). The monthly Industrial News Digest is being issued in printed form from January, 1979.

Insdoc established a Regional Centre at Calcutta; and one at Madras is in the process of establishment in collaboration with the Department of Science & Technology (DST).

The national information centre established at CFTRI under the National Information System for Science and Technology (NISSAT) scheme has been actively engaged in acquiring books and other publications, preparation and issue of Food Technology Abstracts (monthly), Food Digest (quarterly), development of a food science and technology Thesaurus, reprography, translation services and preparation of the Bibliographies and SDI (Selective Dissemination of Information) services.

The National Information Centre for Drugs and Pharmaceuticals set up in CDRI under the NISSAT scheme of DST commenced issue of four monthly bulletins, viz. Current Highlights (R&D), Current Highlights (Industry), Patent Awareness and Current Indian Contents.

The National Information Centre for Aeronautics set up in NAL and the National Information Centre for Leather and Allied Products (NICLAP) in CLRI, the latter under the NISSAT scheme of DST, have been engaged in bringing out special publications, digests and bibliographies for a variety of users.

CSSTD has been recognised as a national input centre for the Unesco sponsored Science Policy Information Exchange Service (SPINES). The Indian National Oceanographic Data Centre (INODC) of NIO has been recognised as a national input centre for several international organisations and the WHO sponsored Marine Environmental Data Information Referrel System (MEDI).

BASIC RESEARCH

Extensive investigations on the structure, imperfections, ordering and other physical properties of liquid crystals were undertaken at NPL. The structure, phase transitions and electrical conductivity of $Cu_{2-x}S$ films deposited by vacuum evaporation at different substrate temperatures were studied. It was found that the deposition parameters significantly affect the composition and the structure of evaporated $Cu_{2-x}S$ films. The stoichiometry changes from copper-rich to copper-deficient, as the substrate temperature is increased. This is explained in terms of the mechanism of growth of these films. The occurrence of phase transitions in these films was studied through measurement of the electrical conductivity as a function of temperature. The results were corroborated by electron microscope and diffraction studies on annealed $Cu_{2-x}S$ films.

Studies were made in detail to explore the possibility of magnetic interactions in superconductors. It was found that the magnetic interactions play an important role in the formation of superconductors. A study on ESR of oxygen radicals in cadmium sulphide was undertaken by the laboratory. ESR spectra obtained from CdS powder (formed by crushing single crystals) showed five different ESR absorption lines under different experimental conditions. These lines have been assigned to different oxygen radicals which are absorbed while crushing in air at room temperature, or heating in air at high temperatures. These studies may be useful in making solar cells from CdS powder.

A study was made on the ozone content variation of the atmosphere. Ozone content was shown to decrease after large particle precipitation effects associated with solar flares. A superposed epoch method was used to bring this out, combining data recorded at a number of stations and for a number of particle events.

Up-dating of the national standards of length, time & frequency vacuum and various electronic parameters received special emphasis.

The laboratory has been successful in developing technology on laboratory scale for processing silicon solar cells of an average efficiency of 8% using polycrystalline material directly. The only raw materials used are cheap metallurgical grade silicon, commercial HCl gas, and commercial hydrogen—all of which are indigenously available. A number of process steps have also been eliminated without significantly compromising the efficiency of the cells. This work is supported by the Department of Science & Technology.

NPL has also developed the technology on the laboratory scale for fabrication of thin film CdS-Cu_2S heterojunction solar cells with efficiencies ranging between 5 and 6% under AMI conditions. The cost projections show that when produced in large scale (about 1-2 metre square per week or more) the cost would be between Rs. 15-30 per watt. This work is receiving financial support from the Tata Energy Research Institute.

The use of metal complexes as homogeneous catalysts in the selective hydrogenation of organic substrates is under study at NCL. The catalytic

activity of a ruthenium complex $RuCl_2(AsPh_3)_3$ in the hydrogenation of liquolic acid was investigated. New organotin compounds of the type $RSnL_3$, R_3SnL, R_2SnL_2, $RSnL_2CL$ and SnL_2 where R= alkyl or aryl and HL= 2-, 5- or 5,7-mono- or -disubstituted-8-quinolinol were synthesised and characterised. The chemistry of a novel route two steps shorter than known published and patented route has been worked out for the synthesis of mebendazole, a widely used anthelmentic. Under the synthesis of steroids, a new annelation technique to introduce the D ring in a simple and elegant way on to a performed BC ring has been successfully developed. The technique will be applied to make useful steroidal drugs like spironolactone.

Detailed quantitative seismicity maps of the Pamir-Hindukush Region have been prepared by NGRI. A zone of tension at great depth in the Pamir-Hindukush Region has been inferred which may be responsible for linear fractures and block movements. Upper mantle velocity structure upto a depth of 640 km was obtained for P and S waves at depth of 390 km in the Okhotak sea region.

Using Sg-P intervals, 71 earthquakes in Koyna Region for the period September 1973 to December 1978 have been located by NGRI. The study helped in delineating a fault running 73°45′E longitude and characterised mostly be left lateral strike slip on a nearly vertical plane. These findings are extremely valuable in comprehending seismic activity in Koyna Region.

Work relating to isolation of a number of compounds from plants having pesticidal physiological properties was done by RRL, Jorhat and three compounds from *Eupatorium odoratum* were isolated and identified as scutellarein tetramethyl ether, sinenoetin and chaleones. The fruit, bark and wood from the plant *Chisocheton peniculatus* Hiren. (fam. Maleaceae) were examined and some new compounds were isolated and the structures elucidated on the basis of chemical and spectroscopic methods. These were identified as (i) 6× 7, Diacetoxymaliaca-1, 14, 20, 22 tetreane-3-one, (ii) 1,2-dihydro-6-acetoxyazidirone, and (iii) 6-acetoxy-16-ox-azadirone.

A new local anaesthetic (Centbucridine) developed by CDRI is under clinical trial phase III. It was found to be effective and safe as a dental cartridge in 102 out of 106 cases tried.

A substance obtained by CDRI from the oleoresin of Comniphore *Mukul* (guggul) has shown good cholesterol-lowering effect and is under evaluation in humans.

Two attenuated strains of *Vibrio cholerae* developed by genetic recombination at CDRI showed better protection than a commercial vaccine in animal experiments and would be followed up with a view to development of an effective live oral vaccine.

RRL, Jorhat has developed a new strain of *Java citronella (Cymbopogon winterianus* jowitt) by chemical mutagenesis, which yields about 37% more

herbs than the earlier strain. The oil obtained from the new strain, Jorlab-C2 contains more citronellal (48.2%) than that obtained from Jorhat strain (40.4%). The yield components such as plant height, number of tillers, number of leaves, length and width of leaves are found to be of a higher order.

A pectin-like fraction has been isolated by CFTRI in yields of 5-6% from field bean husk during the studies on carbohydrates of some Indian staple foods. Cow pea fat has been found to be more effective than Ragi fat in preventing atheroma of experimental animals.

Two new proteins, namely "seminalplasmin" and "ribonuclease seminalplasma (RNAse SPL)" have been isolated from bovine seminal plasma at the Centre for Cellular & Molecular Biology (CCMB). These proteins have an extremely unusual set of properties and are likely to find immediate extensive application as reagents in modern biological research. Other future applications in medicine, animal husbandry and reproductive biology are also possible. Seminalplasmin is a potent anti-microbial agent, acting in an unusual, unique way. RNAse SPL represents a new class of ribonucleases (enzymes that degrade RNA) not described so far. A part of this work was done in collaboration with Prof. K.H. Scheit of the Max Planck Institute for Biophysical Chemistry at Goettingen, West Germany.

It has been shown by ITRC that diethyl hexyl phthalate (DEHP) a leachable plasticiser used in the manufacture of plastic utensils and containers, modifies the fate of drugs in the body and adversely affects the function of male reproductive organs and liver of experimental animals.

Biochemical, cytological and pharmacological studies were continued by ITRC on endosulfan, a pesticide likely to replace DDT, on a variety of biological test systems including live animals, fish, human red blood cell, germinating seeds and flower pollens. Ames test using bacterial mutants and the chromosomal aberration test using bone marrow cells have been introduced to find out the mutagenic potential of pesticides. Studies have been continued on the delayed harmful effects on brain and heart and convulsions induced by chlorinated pesticides. In addition to examining the effects of pesticides residues in food grains on the growth and reproduction of animals, a survey was undertaken of the content of organochlorine compounds in human placentae, serum and human tissues obtained from surgical wards.

Laboratory and pilot plant studies on upflow anaerobic filters at NEERI showed that these filters can be used as simple treatment devices for treating the effluents from septic tanks, primary setting tanks or raw sewage itself. BOD removal percentage of 70-80% was obtained with a hydraulic loading rate of 1.0 to 1.5 m^3/day and a detention time of six to twelve hours. The salient features of the unit are its simplicity in construction, operation and low loss of head in its working.

X-ray studies were continued by CGCRI on physics of ceramic colours for formulating a method by which several cationic concentrations distributed over the equivalent lattice positions in a structure could be determined. Colour ceramics which assume a spinal-type structure were studied and the optimum parameters such as scale factor, oxygen position and atomic concentrations were determined for attaining the best agreement between the intensities of observed reflections and the calculated values.

TRA, for the first time, has found tomato to be an excellent indicator plant for diagnosis of nematode infestation in tea soils which will help in effectively using costly nematixides. A Coccinellid predator has been found to predate extensively on *Aphis craccivora* which is a serious pest of young shade trees of *Indigofera zollingeriana* syn. *I. teysmanni* planted in tea estates. The former promises to be a useful organism in biological control of the latter pests.

HEADQUARTERS ACTIVITIES

The Society of the Council of Scientific & Industrial Research met on 28.12.1978 under the Chairmanship of the President, CSIR (Prime Minister). The meetings of the Governing Body were held on 19th June and 6th October, 1978.

The 29th Conference of Directors of national laboratories/institutes/ research associations was held on 2nd and 3rd June, 1978 at the Central Food Technological Research Institute, Mysore.

The President, CSIR (Prime Minister) presented on 8.2.1979 the Shanti Swarup Bhatnagar Prizes for 1976 and 1977 to 18 scientists (one of them posthumously) for their outstanding work in science and technology.

Prof. M. Santappa, Director, Central Leather Research Institute, Madras and Chairman, Coordination Council for Biological Sciences Group was relieved of his duties on 17.1.1979 to enable him to take up his new assignment as Vice-Chancellor, Sri Venketeswara University, Tirupati. Dr. Nitya Nand, Director, Central Drug Research Institute, Lucknow will be the new Chairman for the Biological Sciences Group. Shri K.D. Sharma, Director, Central Glass & Ceramic Research Institute, Calcutta, has taken over the Chairmanship of the Engineering Sciences Group.

The Management Development Unit of the Planning Division, CSIR organised a workshop on 'Gaon-ke-Karigar-Aur Science' (Village Artisans and Science) from 7th to 11th September, 1978 at Sevagram, Wardha in collaboration with the Centre of Science for Villages, Wardha for discussing the problem of technology transfer to rural areas. Sixty-two participants including scientists from nine national laboratories, artisans and promoters in the areas of food processing, leather, pottery, carpentry and blacksmithy, rural civil engineering, habitat and environment, attended the workshop.

A two-day get-together (29-30 December, 1978) of 63 scientists from 11 national laboratories and promoters discussed the follow-up problems of the workshop at Wardha. This was followed by a discussion meet between the scientists and the Prime Minister and a memorandum giving the final recommendations was presented to him. An exhibition on the rural technologies developed by the CSIR laboratories was organised during this get-together.

Under the agreement for scientific and technical collaboration between CSIR and the State Committee for Science & Technical Cooperation, Bulgaria, a Protocol of sixth session of the Indo-Bulgarian Joint Sub-Commission for Scientific & Technical Cooperation was signed in New Delhi on 17 Jan. 1979.

Following the visit of a delegation from CNRS, France, an understanding has been signed on 3rd February, 1979 between CSIR and CNRS for possible areas of cooperation and exchange of scientists.

CSIR is setting up Poly-technology Transfer Centres (PTC) in the state capitals with the financial participation of the concerned State Governments

plant in Madhya Pradesh from November 1978, based on the continuous catalytic vapour phase methylation of aniline to dimethylaniline—a process developed at the National Chemical Laboratory (NCL), Pune.

The vapour phase catalytic process developed is unique and the first of its kind in the world. The activity of the catalyst is maintained at a steady value by continuous introduction alongwith the feed stream of an activating agent.

M/s Sahyadri Dyestuffs and Chemicals, during November 1978 - March 1979, have produced 756.35 tonnes of DMA by continuous process, valued at Rs. 180.46 lakhs.

Ethylenediamine is a versatile chemical. M/s Diamines and Chemicals Ltd., Kalol, Gujarat are installing a 1000 tpa plant based on the NCL know-how. NCL is assisting the firm in the design of the commerical plant. The plant is due to go on stream by the end of the year 1980. NCL had developed the know-how for the dyestuff intermediates, anisidines and toluidines on behalf of Amar Dye Chem Ltd., Kalyan. NCL scientists assisted the firm in conducting trials at their works. This firm has also started pilot plant production of simazine based on the NCL know-how.

The process for the systemic insecticide dimethoate was released and demonstrated to the representatives of (a) M/s PNM & Co., Erode and (b) Mico Farm Chemicals Ltd., Mettur Dam.

NEERI provided assistance to a large number of industries by undertaking sponsored projects, analysis of water and waste water samples and by providing consultancy services. Among the major industries assisted were M/s Hindustan Antibiotics Ltd., Pimpri, M/s Sirpur Paper Mills Ltd., Sirpur Kaghaznagar (A.P.), M/s Hindustan Insecticides Ltd., Rasayani, M/s Sugar Co., Mandya (Karnataka), M/s North Bihar Sugar Mills, Bagala (Bihar) and M/s Hindustan Photo Films Co. Ltd., Ootacamund (Tamil Nadu).

Based on the flow sheet developed by NEERI, M/s Amines and Plasticisers Ltd., Bombay are building a biological treatment system to treat 77 m^3/d waste waters so as to bring down the pollutants to the tolerance limits laid down by the Maharashtra Prevention of Water Pollution Board, Bombay for discharge into creak waters.

A project on sintering of iron ore fines was undertaken by RRL (Bhu.) in collaboration with M/s Kalinga Iron Works, Barbil, Orissa, (a unit of the Industrial Development Corporation of Orissa). A pilot plant of 30 tonnes per day of non-fluxed iron ore sinters, (20 tonnes of fluxed sinters) has been set up at KIW based on the process and design know-how provided by the laboratory.

Batch studies (80 to 100 kg) on the preparation of synthetic rutile through column leaching of partially reduced ilmenite with preheated hydrochloric acid have been completed. A report on this was prepared and submitted by the laboratory to M/s Mettur Chemicals and Industrial Corporation Ltd., Mettur Dam, Tamil Nadu, the sponsore of the project.

The Centre sponsored a study on 'the Values and Attitudes of Science-trained Working Women in Bombay' in collaboration with the SNDT Womens' University, Bombay.

The Centre also prepared a paper on "Appropriate Technology—some issues and problems" for UNIDO Conference in Appropriate Technology.

The Extra-Mural Research (EMR) Unit processed ninety-three research schemes for sanction during the year. The total number of research schemes currently in progress is 387. A total of 302 Junior Research Fellowships, 191 Senior Research Fellowships and 15 research associates have been sanctioned for three schemes. The work in 152 research schemes was concluded during the year on completion of tenure. These were also processed by EMR Unit.

About 1500 new research fellows, both Senior and Junior, accepted the fellowships offered by CSIR and joined during the year. The number of direct research fellows as on 1st March, 1979 receiving assistance from CSIR is about 3900 (3500 in academic and research institutions other than CSIR and 400 in CSIR laboratories/institutes).

A new scheme for the award of direct research associateship in the range of Rs. 1000 to 1400 p.m. was initiated by EMR Unit during the year. Out of 500 applicants, 20 were selected for the award.

Another activity of EMR Unit related to grants for dissemination of science. Grants were given to 10 language periodicals engaged in popularisation of science through the medium of regional languages. Of these, three are in Hindi, three in Malayalam, two in Tamil and one each in Bengali and Marathi. Grants were also recommended for two new journals, one in Gujarati and the other in Kannada.

Grants were given to learned societies for organisation of about 38 symposia/seminars of CSIR interest.

The Public Relations and Science Reporter Unit continued to maintain close contact with the Press and mass media to project the achievements of CSIR and the national laboratories. A science section was organised in the Indian Exhibition at Moscow in August 1978. Preparations are on for organising a CSIR pavilion in the First India International Trade Fair 1979.

The popular science monthly of CSIR, Science Reporter, published by this unit, has entered its fifteenth year of publication with a circulation of over 57,000 copies per issue.

The administrative control of the Indian Languages Unit and the Science-ki-Duniya was transferred from the CSIR Headquarters to PID with effect from the 12th October, 1978.

SOME SIGNIFICANT HONOURS AND AWARDS

Contributions of scientists of CSIR have been recognised by national and international agencies/associations. Some of the significant honours/awards in recognition of their contributions are listed below:

1. Dr. A. Ramachandran, former DGSIR, was appointed Executive Director of the U.N. Centre for Human Settlement at Nairobi.
2. Dr. M. Mahadevaiah, Shri W.E. Eipeson, Smt. R.V. Gowramma & Dr. L.V.L. Shastry of CFTRI, Mysore, were awarded the K.U. Patel Memorial Award for 1977 by the All India Food Preservers' Association.
3. Shri A. George Verkey, Shri A.V. Bhat and Smt. S.K. Krishnan Kutty of CFTRI, Mysore, were awarded the N.N. Mohan Memorial Award by the All India Food Preservers' Association.
4. Dr. A.P. Mitra, NPL, New Delhi has been elected a Vice-President of the International Union of Radio Science (URSI). He was also awarded the Jawahar Lal Nehru Fellowship for 1978.
5. Dr. K.L. Kaila, NGRI, Hyderabad, was awarded the S.S. Bhatnagar Award for 1977 (Earth Sciences).
6. Dr. S.M. Naqvi, NGRI, Hyderabad, was awarded the Mysore Geologists' Association Gold Medal by the Geological Society of India.
7. Prof. B.K. Bachhawat, Director, IIEM, Calcutta, was elected President of the Council of the Indian Association for the Cultivation of Science, Calcutta for a three-year term from March 1978.
8. Dr. P.A. Paranjpe, NAL, Bangalore, was awarded the 1978 Fuel Instruments and Engineers Foundation Award.
9. Dr. D.S. Bhakuni of CDRI, Lucknow, was elected Fellow of the Indian National Science Academy.
10. Dr. P.M. Bhargava, RRL, Hyderabad, was elected Fellow of the Indian National Science Academy.
11. Dr. A.G. Datta, IIEM, Calcutta, was elected Fellow of the Indian National Science Academy.
12. Dr. H.K. Gupta of NGRI, Hyderabad, was awarded the Krishnan Gold Medal for 1978 by the Indian Geophysical Union.
13. Dr. L.K. Doraiswamy, Director, NCL, Pune, has won the Herdillia Award for excellence in basic research in Chemical Engineering.
14. Prof. Harsh Vardhan, Director, CSIO, Chandigarh, has been awarded (jointly with Prof. M.A. Pai of the Indian Institute of Technology, Kanpur) the Federation of Indian Chambers of Commerce and Industry (FICCI) Award in Science and Technology for the year 1978.
15. Dr. M.I.H. Farooqui and Shri R.K. Tandon of NBRI, Lucknow, have been jointly awarded 'Kheti Puraskar' in Agricultural Sciences for 1977-78 by the Indian Council of Agricultural Research, New Delhi.

Chem Kar (P) Ltd., Karaikudi have commenced commerical production of calcium gluconate, based on CECRI technology. Glucose is oxidised, at the rotating anode, to gluconic acid and this is treated with calcium carbonate to get calcium gluconate.

Chem Metals, Virudunagar have commenced trial production of tin from tin scrap. In this process of CECRI, tin is dissolved preferentially from the scrap and recovered from the solution by chemical displacement.

Spheroidal Castings Ltd., Madras and sponsored at CECRI a scheme for the development of magnesium-silicon alloy for use in spheroidal graphite cast iron. After successful demonstration of the process by CECRI, the firm has commenced trial production of the alloy.

A process has been developed for the production of calcium silicide in a 380 kVA arc furnace designed, fabricated and operated at CECRI. Calcium silicide is used as a de-oxidising and desulphurising agent in iron and steel industry. This process has been licensed to the Silical Metallurgic (P) Ltd., Coimbatore.

A device for producing dilatation of the cervix has been fabricated by CDRI from the seed husk of psyllium plant (isabgol) for use as an aid in medical termination of pregnancy. Designated "Isp-tent", the device causes the desired degree of dilation and is a suitable and cheap substitute for the imported "laminaria tent". After successful completion of field trials the device has been approved by the Drugs Controller (India) for production and marketing. The process has been assigned to NRDC for licensing to industry.

Psyllium seed husk has been formulated to palatable laxative granules; the CDRI preparation compares well with similar products sold abroad and is likely to have a good export market. The process has been assigned to NRDC for release to industry.

Arrangements are underway for handing over a process developed by IIEM for isolation of galactose binding lectin, using affinity chromatography, to a firm in Calcutta.

An experimental model for a drier for drying green cardamom has been made by RRL, Trivandrum with the help of CFTRI. Field studies in a cardamom estate have given encouraging results and the equipment is ready for release.

Laboratory studies for separation of pungency and colour of chilli oleoresin have been completed by RRL, Trivandrum. The scaling up studies have indicated the possibility of setting up small scale industrial units for producing high pungency low colour oleoresin with pharmaceutical application. The process is ready for release and some contacts for this have already been established. The laboratory has also developed a process for dry packing of green pepper and control of fungus on black pepper.

A partially defatted coconut flour has been prepared by RRL, Trivandrum and this product is found to be satisfactory for use in curries and other preparations. The process is ready for release.

CSIR TOTAL EXPENDITURE

(Rs. in lakhs)

	1976-77*			1977-78*			1978-79		
	Non-Plan (1)	Plan (2)	Total (3)	Non-Plan (4)	Plan (5)	Total (6)	Non-Plan (7)	Plan (8)	Total (9)
1. Central Administration	314.181	23.875	338.056	334.388	32.643	367.031	388.060	27.810	415.870
i) Pay and Allowances Contingencies Maintenance	106.597	1.989	108.586	107.944	3.174	111.118	121.579	1.652	123.231
ii) Headquarters Technical Activities	8.169	8.944	17.113	6.749	11.740	18.489	10.099	8.079	18.178
iii) Misc. Pensions, Advances, etc.	199.415	12.942	212.357	219.695	17.729	237.424	256.382	18.079	274.461
2. Laboratories	2422.169	1098.417	3520.586	2558.617	1473.942	4032.559	2389.270	1480.640	3869.910
3. Scientists' Pool	66.807	—	66.807	60.078	—	60.078	59.580	—	59.580
4. Research Schemes, Scholarships and Fellowships	166.000	86.234	252.234	169.070	136.880	305.950	167.840	122.960	290.800
5. Industrial Research Associations	100.000	67.564	167.564	100.000	75.818	175.818	43.500	11.970	55.470
6. Pilot Plants	—	126.112	126.112	—	138.054	138.054	—	136.600	136.600
7. Residential Buildings	88.479	—	88.479	174.314	—	174.314	40.450	133.700	174.150
Total	3157.636	1402.202	4559.838	3396.467	1857.337	5253.804	3088.700	1913.680	5002.380

*Includes Transferred Laboratories.

APPENDIX I

PROCESSES WHICH HAVE GONE INTO PRODUCTION FOR THE FIRST TIME DURING 1978-79

Sl. No.	Process	Party	Nature of Licence
		Food Industry Including Beverages	
	CFTRI		
1.	Canned drinking water	J.M.S. Life Saving Appliances, Bombay	Technical aid
2.	Pectic Enzyme	Micozyme Industries, Bangalore	Technical aid
		Chemicals	
	CECRI		
3.	Sodium chlorate	Chlorate India Pvt. Ltd., Tirupati	Non-exclusive
4.	Ammonium perchlorate	I.S.R.O., Alwaye	Non-exclusive
	NCL		
5.	Tricholorobenzenes	Mycol International Agents, Madras	Non-exclusive
6.	Polyurethane coating	1. Polyurethane Industries, Ahmedabad	-do-
		2. Cipy chemicals, Poona	-do-
7.	Maleic hydrazide	Microchemicals (India) Mandsaur (MP)	-do-
	CSMCRI		
8.	Alginic acid/sodium alginate from Indian sea weeds	Belur Chemical Industries, Mysore	-do-
9.	Rescalite	Bromolide India Ltd., Calcutta	-do-
	RRL, Jammu		
10.	Menthol from dementholised mint oil	1. Urmila Drugs & pharmaceuticals, Ghaziabad	Non-exclusive
		2. Wadhwa Chemical & Allied Industries, Delhi	-do-
	RRL, Jorhat		
11.	Oilwell cement additive	Hico Products Pvt. Ltd., Bombay	Non-exclusive
12.	Potassium silicate	Electrochem Enterprises, New Delhi	-do-
	RRL, Hyderabad		
13.	Cyclohexane	G.S.F.C., Baroda	Collaborative work
14.	Wettable sulphur	IA & IC Pvt. Ltd., Bombay	Sponsor
15.	Low-temperature carbonisation of coal	Coal Chemical Complex, Naspur	Non-exclusive

PROCESSES WHICH HAVE GONE INTO PRODUCTION FOR THE FIRST TIME DURING 1978-79

Sl. No.	Process	Party	Nature of Licence
	SRIFIR		
16.	Carboxymethyl Starch (IP NO, 99657)	Adhesives & Chemicals, Madras	Non-exclusive
	IIEM		
17.	Gelatin optical filters	Prakash Chemical Laboratory, Pune	-do-
		Electrochemicals	
	CECRI		
18.	Rust convertors	1. Rustom Industries	-do-
		2. Somson Enterprises, Bangalore	-do-
		3. Interport (Asiatic) Co., Madras	-do-
19.	Titanium Substrate	Titanium Equipment Anode Mfg. Co., Madras	Non-exclusive
20.	Corrosion prevention in reinforced concrete and brick construction	Manner and Anticorrosion Industry, Nasik Road	-do-
	CMERI		
21.	Electrochemical marking machine	Vinaj Engineers, Poona	Sponsored
		Drugs & Pharmaceuticals	
	CDRI		
22.	Indomethacin	Kembiotic Collaborators, Bombay	-do-
23.	Cyproheptadine	Kembiotic Collaborators, Bombay	-do-
		Metallurgy	
	CECRI		
24.	Magnesium silicon alloy	Special Casting Pvt. Ltd., Madras	Non-exclusive
	NML		
25.	Dental amalgam alloy	Shakti Industries, Varanasi	-do-
26.	Bi-metallic powder	Paras Metal Powders, Nasik	-do-
27.	Zinc dust from Zinc dross (Galvanising)	Associated Pigments, Calcutta	-do-

APPENDIX I

PROCESSES WHICH HAVE GONE INTO PRODUCTION FOR THE FIRST TIME DURING 1978-79

Sl. No.	Process	Party	Nature of Licence
		Materials	
	CGCRI		
28.	Glass ceramic materials	Technical Glass Ceramics, Raniganj	Non-exclusive
29.	Glass for glass to metal seals	Technical Glass Ceramics, Raniganj	-do-
30.	Sodium and potassium ion selective glass electrodes	Elico Pvt. Ltd., Hyderabad	-do-
31.	Lead free and low lead vitreous enamels for wire mould resistors	Resistors & Enamels, Varanasi	-do-
32.	Copper ruby glassware	Manohar Glassworks, Ferozabad	Technical aid
33.	Low impedance glass electrode	1. ECIL, Hyderabad	Non-exclusive
		2. Electronic Measurement (I) Pvt. Ltd., Calcutta	-do-
		3. Pathakote Electronic, Bangalore	-do-
	CSMCRI		
34.	Spirally enhanced heat transfer tubes	Plastic Art & Jeecee Chem (I), Bombay	-do-
35.	Friction prop with steel like bar	Mashstra (I) Pvt. Ltd., Jaunpur	Sponsored
	RRL, Jorhat		
36.	Correction paper	Ashwani Amratlal Shah, Ahmedabad	Non-exclusive
37.	Matric Board (Rubber Stereo & Sterlong)	Usha Paper Board Industries, New Delhi	-do-
		Machinery	
38.	Hydraulic sammying machine	Solai Engineering Co., Madras	Collaborative work
	NPL		
39.	Solid Carbondioxide Machine	Indo Burma Petroleum Co., Ltd., Bombay	Non-exclusive
		Electronics	
	CEERI		
40.	Test equipment for transistorised excitation control system for diesel electric locomotives	V.K. Industries, Pilani	Technical aid

APPENDIX I

PROCESSES WHICH HAVE GONE INTO PRODUCTION FOR THE FIRST TIME DURING 1978-79

Sl. No.	Process	Party	Nature of Licence
		Instruments	
	CMERI		
41.	Pencil type coating thickness gauge	Asim enterprises, Calcutta	Non-exclusive
	NPL		
42.	Vacuum leak detector	Vacuum Instruments, New Delhi	-do-
43.	Angle beam probes & surface wave probes for ultrasonic non-destructive testing equipment	Technotronics Industries, New Delhi	-do-
44.	Industrial vacuameter	Vigyan Udyog, Meerut	-do-
		Building Materials	
	CBRI*		
45.	Improved burning of limestone	Housing Material Suppliers, Tuticorin	Non-exclusive
46.	Wood wool board from wood wool and portland cement and/or magnesium oxychloride cement	1. Ravikul Board Products, Aligarh	-do-
		2. Grafex-Machinery Company, Madras	-do-
		3. Neotric Manufacturers, Kota	-do-
47.	Door and window frames from magnesium oxychloride cement and saw dust	S.P. Gangal Company, Bhopal	-do-
48.	Water impermeable drain	G.S. Jain & Associates, Roorkee	-do-
49.	Kettle for manufacture of gypsum plaster for plaster of paris	Triveni International, Bombay	-do-

*CSIR processes assigned to NRDC before CBRI was transferred to the Ministry of Works & Housing

APPENDIX II

PROCESSES RELEASED TO INDUSTRY FOR THE FIRST TIME IN 1978-79

Sl. No.	Process	Party
	Food Industry, Including Beverages	
CFTRI		
1.	Egg coating oil	M/s Venkateshwara H. Pvt. Ltd., Hyderabad
2.	Egg washing powder	M/s Venkateshwara H. Pvt. Ltd., Hyderabad
3.	Wax emulsion	1. M/s Indian Chemical Specialities, Nagpur 2. M/s Vasudeva N. Deshpande, Morshi (Maharashtra)
4.	Tamarind powder	M/s A. Rangaswamy Chettiar, Coimbatore, Shri Prem Chandra, Manasagangotri, Mysore
5.	Amyloglucosidase	Kamala Sugar Mill, Amarvati Nagari, Udumalpet, Tamil Nadu
	Chemicals	
CECRI		
6.	Potassium & Sodium bromate	M/s Ranganayak Chemicals Pvt. Ltd., Madras
7.	Calcium Silicide	M/s Silical Metallurgical (P) Ltd., Coimbatore
8.	Potassium and Sodium Iodates	Bush Boake Allen India Ltd., Madras
CLRI		
9.	Fatliquor (Cenlesols 12 & 30)	M/s Dermachem, Madras
10.	Syntan NC, NCS, PN, PPN, PC, PUP, PNS, PNU, PCB, NB, PKR, PMR, NCR, CRP, MMS	M/s Tata Exports Ltd., Bombay
NBRI		
11.	Distillation of essential oil and perfumed water	Shri Dhiraj Lal Mohan Lal Joshi, Rajkot
NCL		
12.	Dimethoate (Tech.)	M/s Mico Farm Chemicals Ltd., Madras
13.	Ethepon	M/s Joha & Satya Chemicals Pvt. Ltd., Bangalore
14.	Butyloctyl phthalate	M/s Herdillia Chemicals Ltd., Bombay
15.	Ethion	M/s Shaw Wallace & Co., Calcutta
RRL, Bhubaneswar		
16.	Isatoic anhydride from phthalamine	M/s Shree P.M. Hegde, Dandeli
RRL, Hyderabad		
17.	Glass-lining of chemical processing equipment	Vapour Products Industries Ltd., Bombay
18.	Diazinon	Sudarshan Chemical Industries Ltd., Pune
19.	Tetradifon	Excel Industries Ltd., Bombay
20.	Trimethyl phosphite	Sudarshan Chemical Industries, Pune
21.	Epoxy resins	Chemicine Engineering Corpn., Bombay
22.	Glyoxal	1. Manish Organics India Ltd., Ahmedabad 2. Rajasthan Glyoxal Ltd., Jaipur

PROCESSES RELEASED TO INDUSTRY FOR THE FIRST TIME IN 1978-79

Sl. No.	Process	Party
RRL, Jorhat		
23.	Quinalphos (jointly with RRL, Hyderabad)	Sudarshan Chemical Industries Ltd., Pune
24.	Cycocel	Vividh Pharmaceuticals, Bombay
25.	Phosphamidon	Sudarshan Chemical Industries Ltd., Pune
RRL, Jammu		
26.	Ionones	Essential Oils and Chemicals, Bareilly
	Electrochemicals	
NCL		
27.	Silver paste for mica capacitor electrode	M/s Ramans India, Ambala City
	Drugs & Pharmaceuticals	
CDRI		
28.	Metol	M/s National Solvent Corpn., Bombay
29.	D-2 Aminobutanol	Themis Chemicals, Bombay
30.	Calcium Levulinate	M.M. Labs., Bombay
31.	Ethacridine lactate	M.M. Labs., Bombay
32.	Ampicillin	Alembic Chemical Works Co. Ltd., Baroda
33.	Cyclophosphamide	Sarabhai Research Centre, Baroda
RRL, Jammu		
34.	Citronellol	Essential Oils & Chemicals, Bareilly
35.	Hydroxy citronellol	Essential Oils & Chemicals, Bareilly
	Metallurgy	
CECRI		
36.	Chromate treatment of zinc and die cast zinc alloy	M/s Carburettors Ltd., Madras
NML		
37.	Copper clad aluminium sheets and strips	M/s Adarsh Engineers, Jamshedpur
38.	Nickel magnesium alloy	M/s Industrial Minerals & Metals, New Delhi
	Materials	
CGCRI		
39.	Fibre glass and fibre reinforced plastics	1. Chandra Gupta Co., Delhi 2. Basu Dev Dutta Roy, Calcutta 3. Smt. Radhmani Varshne, Calcutta
40.	Copper ruby glassware	Manohar Glass Works, Ferozabad
RRL, Hyderabad		
41.	Colloidal graphite	M/s Industrial Graphite, Hyderabad

PROCESSES RELEASED TO INDUSTRY FOR THE FIRST TIME IN 1978-79

Sl. No.	Process	Party
RRL, Jammu		
42.	Dental plaster of Paris	Plastona Industries, Pune
	Machinery	
CMERI		
43.	Tip ice machine	Hindustan Refrigeration Stores, Calcutta
44.	Air filter test rig and lube oil filter test rig	Winston Engineering Works, Calcutta
45.	Hydraulic coil expanding and spreading machine	Jyoti Ltd., Baroda
46.	Pedal loom	SAS Industries, Patna
47.	Skaneyes holding structure	Skan International, Calcutta
	Electronics	
CEERI		
48.	Printed circuit board drilling machine	M/s Pal Industries, Sangrur
49.	Toroidal coil winding machine	M/s Dal Industries, Sangrur
50.	5 kwh RF induction furnace	M/s Pal Industries, Sangrur
51.	Thyristor Convertors 150	Central Electronics Ltd., Shahibabad
52.	Magnetrons	Central Electronics Ltd., Shahibabad
NPL		
53.	Simultaneous inter-communication system	M/s Saral Enterprises, Delhi
54.	Mobility aid for blind	Shri Ashok Kumar Verma, New Delhi
	Instruments	
55.	Digital temperature lineariser	M/s Precision Instruments & Electrodes, Madras
CMRS		
56.	Gravimetric dust sampler modified design	Johura Kali Enterprises, Calcutta
CSIO		
57.	Feotus stethoscope	M/s Mangla Electronics, New Delhi
58.	Digital optical density meter	M/s Photo Electric Instrument, Jodhpur
59.	Digital tachometer	M/s Thermodyne Pvt. Ltd., Delhi
NAL		
60.	Automatic radio rain-gauge teleprinter system	Raman Research Institute, Bangalore
NEERI		
61.	Wind direction recorder	Speedicut Industrial Products, Nagpur
62.	Wind speed recorder	Speedicut Industrial Products, Nagpur

PROCESSES RELEASED TO INDUSTRY FOR THE FIRST TIME IN 1978-79

Sl. No.	Process	Party
NPL		
63.	3-D panoramic photo-graphic display	M/s Publicity Promotion Products, Bombay
RRL, Bhubaneswar		
64.	Earth augar	M/s Assam Industries, Hojal
	Others	
RRL, Jorhat		
65.	Domestic fuel from Assam Coal	Assam Coal Products, Golaghat
66.	Low cost bamboocrete house	6 parties

APPENDIX III

CSIR PATENTS FILED* ACCEPTED & SEALED IN INDIA AND ABROAD DURING THE PERIOD 1.4.78 TO 31.3.79

	INDIA			ABROAD		
	Filed	Accepted	Sealed	Filed	Accepted	Sealed
CECRI, Karaikudi	18	25	20	—	1	—
CDRI, Lucknow	12	3	5	—	—	—
RRL, Bhubaneswar	12	9	10	—	—	—
NCL, Pune	11	4	1	—	—	—
NPL, New Delhi	9	5	8	—	—	—
RRL, Hyderabad	8	5	1	—	—	—
CLRI, Madras	5	1	—	—	—	—
CMERI, Durgapur	5	9	2	—	—	—
RRL, Jorhat	4	5	7	—	—	—
CBRI, Roorkee	3	1	1	—	—	—
CIMAP, Lucknow	3	1	—	—	—	—
IIEM, Calcutta	3	1	—	—	—	—
IIP, Dehra Dun	3	4	3	—	—	—
NEERI, Nagpur	3	2	—	—	—	—
CEERI, Pilani	2	—	11	—	—	—
CMRS, Dhanbad	2	1	—	—	—	—
NAL, Bangalore	2	1	—	—	—	—
NIO, Goa	2	1	1	—	—	—
CFRI, Dhanbad	1	3	12	—	—	—
CGCRI, Calcutta	1	1	—	—	—	—
CSMCRI, Bhavnagar	1	1	1	—	—	—
MERADO, Ludhiana	1	—	—	—	—	—
MERADO, Madras	1	—	1	—	—	—
NML, Jamshedpur	1	3	7	—	—	—
NBRI, Lucknow	—	1	—	—	—	—
CSIR Schemes	—	5	—	—	—	—
SERC, Roorkee	—	1	1	—	—	—
IPIRI, Bangalore	—	2	—	—	—	—
IRMRA, Bombay	—	1	—	—	—	—
	113	95	92	—	1	—

*Includes CSIR's transferred laboratories

APPENDIX IV

DESIGN AND CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

Sl. No.	Field	Name of the laboratory	Design capabilities developed	Consultancy services offered
1.	Physics based industries	National Physical Laboratory (NPL), New Delhi	Metal working facilities for extruded tubes of sections of materials, specialised laboratory equipment, optical systems, solar energy utilisation, communication systems and radio science	Acoustics in auditoria, conference halls, vacuum technology, carbon technology, thin film optical coatings, microwave laboratory, utilisation of solar energy, manufacture of ferrites and ceramic products, calibration, testing and standardisation of industrial products falling under physical sciences
2.	Electronics	Central Electronics Engineering Research Institute (CEERI), Pilani	Design & consultancy capabilities available in the areas of vacuum tubes, solid state devices, electronic control systems and instrumentation, communication systems and television, audio and acoustics systems	
		NPL	Design of electronic analogue and digital circuitry, instrument systems and controls	
		NAL	Control systems	
		CMERI	Electronics in mechanical engineering	
3.	Geophysics	National Geophysical Research Institute (NGRI), Hyderabad	Design development and fabrication of a wide range of geophysical instruments, air-borne and ground geophysical surveys, geophysical and geohydrological studies, deep-seismic sounding studies, geochemical analysis of rocks, etc. (Consultancy in these areas)	

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DESIGN AND CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

Sl. No.	Field	Name of the laboratory	Design capabilities developed	Consultancy services offered
4.	Oceanography	National Institute of Oceanography (NIO), Dona Paula, Goa	Marine instruments, marine engineering work (harbours, fishing piers, silting, dredging sand bars, etc.)	Pollution control, offshore oil fields, coastal protection
5.	Chemical Engg. (basic organic, inorganic and marine chemicals, dyes, intermediates, agrochemicals including pesticides, etc.	National Chemical Laboratory (NCL), Pune	For a wide range of basic engineering designs. The laboratory has a process design and optimisation cell. Computer aided design techniques and sophisticated optimisation procedures for reactor and plant optimisation are being adopted in preparing design packages	The lab. has been appointed as consultant by parties exploiting NCL technologies for detailed engineering design, equipment procurement, commissioning and troubleshooting. Scientists of the lab. act as consultants for the planning of R&D Centres of major industrial complexes
		Central Salt and Marine Chemicals Research Institute (CSMCRI), Bhavnagar	Complete design of salt works both in India and abroad	Can offer consultancy to salt works, marine chemical industries and desalination plants
		Regional Research Laboratory (RRL), Hyderabad	Basic design and post-design assistance offered on production of organic chemicals, drugs, dyes, paints, pesticides, and coal carbonisation processes. Computer aided design techniques for process control followed	As in Column No.4
6.	Electro chemistry (electrometallurgy, corrosion, etc.)	Central Electrochemical Research Institute (CECRI), Karaikudi	Design & Consultancy capabilities offered for electrochemical and allied industries, e.g. design of electrolytic cells, electric arc furnace, identification, control and prevention of corrosion, metal finishing, batteries and instruments for electrochemical industries	

APPENDIX IV

DESIGN AND CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

Sl. No.	Field	Name of the laboratory	Design capabilities developed	Consultancy services offered
7.	Drugs	Central Drug Research Institute (CDRI), Lucknow	Drug design, preclinical studies, clinical pharmacology (phase I) and drug metabolism	Evaluation of project reports for setting up new units, advising on product mix for new units, standardisation, suitability of equipment, etc.
8.	Food processing	Central Food Technological Research Institute (CFTRI), Mysore	Equipment designs, process designs, scale-up and engineering studies, plant designs for food industry	Techno-economic feasibility studies, regional resource and industrial surveys, commercial project evaluations, process evaluation and modification and project consultancy for setting up food processing industries
		Regional Research Laboratory (RRL), Trivandrum		Canning, drying and processing of horticultural produce
9.	Phytochemicals	Regional Research Laboratory (RRL), Jammu	Design, engineering, fabrication and installation of plants for phytochemicals, perfumery and flavour chemicals, fermentation plants, solvent extraction plants, heat exchangers	As in Column No.4
10.	Medicinal and Aromatic Plants	Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow		Preparation of feasibility reports on agrotechnology and processing of medicinal and aromatic plants
		National Botanical Research Institute (NBRI), Lucknow		Pharmacognosy of indigenous drugs, extraction of essential oils and perfumes
11.	Ornamental Plants	National Botanical Research Institute, (NBRI), Lucknow		Garden layout and landscaping, fresh and dehydrated flower & foliage
12.	Materials	Regional Research Laboratory (RRL, Trivandrum)		Consultancy for clay based materials like bricks, tiles, etc.

APPENDIX IV

DESIGN AND CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

Sl. No.	Field	Name of the laboratory	Design capabilities developed	Consultancy services offered
	Glass & Ceramics	Central Glass & Ceramic Research Institute (CGCRI), Calcutta	Designing of glass and ceramic testing equipment and furnaces, evaluation of naturally occurring raw materials	Consultancy services in fields of glass, optical and ophthalmic glass, glass ceramics, whiteware refractories, mica and vitreous enamels
13.	Leather	Central Leather Research Institute (CLRI), Madras	Designing of leather goods, tanning and finishing machinery	Techno-economic and marketing surveys for leather and leather products, manufacturing units of leather, leather goods, leather chemicals, tanning and finishing machinery, utilisation of slaughter house and tannery by-products, treatment and disposal of tannery effluents
14.	Civil Engineering (Structures)	Structural Engineering Research Centre (SERC), Madras	Complete design and construction of civil engineering structures. Turn-key Projects can be undertaken both in India and abroad)	Analysis, design, production and construction of all types of structures-concrete or steel (Major areas-shells and machine foundations, transmission line television and microwave towers, water-tanks, offshore-structures, grain-storage structures, medium and long-span bridges, high-rise buildings, digital computation, etc.
15.	Environmental Engineering	National Environmental Engineering Research Institute (NEERI), Nagpur	Design and consultancy capabilities in the areas of water, waste water, solid waste, air pollution integrated rural development and environmental impact analysis	

APPENDIX IV

DESIGN AND CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

Sl. No.	Field	Name of the laboratory	Design capabilities developed	Consultancy services offered
16.	Industrial Toxicology	Industrial Toxicology Research Centre (ITRC), Lucknow		Consultancy services in the areas of safety evaluation of chemicals and the extent of occupational hazards and ways and means of alleviating or preventing them
17.	Mechanical Engineering	Central Mechanical Engineering Research Institute (CMERI), Durgapur	Machine tools (special purpose including tribology) agricultural machinery and farm implements, industrial machinery refrigeration and air-conditioning equipment, open-web structures, cranes, etc., vibration and noise control, heat power engineering, computer aided design procedures	As in Col.4 and on in-plant studies for improving productivity, experimental strees analysis, failure analysis, engineering materials/equipment calibration of instruments/machines/gauges etc.
		Mechanical Engineering Research & Development organisations (MERADO)	Special purpose machines, welding equipment, etc.	-do-
18.	Mining	Central Mining Research Station (CMRS), Dhanbad	Design of mining equipment and components	All problems relating to mine working e.g. hydraulic stowing and blasting, environment control, safety equipment, etc.
19.	Metallurgy	National Metallurgical Laboratory (NML), Jamshedpur	Predesign feasibility reports for utilisation of indigenous ores and minerals designs for mini cupola for rural areas R&D units in industry, solution of corrosion problems	Process consultancy services for establishment of industrial plants (beneficiation of graphite, V_2O_5 from alumina sludge, beneficiation of fluorspar, electrolytic MnO_2, etc.)
20.	Aeronautics	National Aeronautical Laboratory (NAL), Bangalore	Flight vehicles design and development structures, materials, turbo-machinery and control systems, etc.	As in Col. No.4

APPENDIX IV

DESIGN AND CONSULTANCY CAPABILITIES IN NATIONAL LABORATORIES

Sl. No.	Field	Name of the laboratory	Design capabilities developed	Consultancy services offered
21.	Instrumentation	Central Scientific Instruments Organisation (CSIO, Chandigarh)	Precision, digital test and measuring instruments, information display systems, process control and monitoring systems, electron optics and imaging devices/precision optics components, components for surface analytical instrumentation, etc.	Feasibility reports on setting up instruments manufacturing units, market surveys for the instrument industry, medical electronics, process instruments, optical instruments, design and development, industrial designs, etc.
		CEERI	Electronic test instruments and electronic process control instrumentation	
		NGRI	Geophysical instruments	
		NIO	Marine instruments	
		CECRI	Electrochemical Instruments	
22.	Information Technology	Indian National Scientific Documentation Centre (INSDOC), New Delhi		Consultancy services in reprography, information technology and computerised processing of bibliographic information
23.	Tea	Tea Research Association (TRA), Jorhat	Designing irrigation and drainage systems in macro as well as micro scales and designing machinery for tea processing	In the areas of tea industry, machinery, processing, water management, manuring tea, young tea management, plant protection measures, pruning and plucking green tea leaf, etc. Assessment of techno-economic feasibility of the plantation in non-traditional areas is also done

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