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ANNUAL REPORT 1980-81

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
NEW DELHI

ANNUAL REPORT 1980-81

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

PRESIDENT	SMT. INDIRA GANDHI Prime Minister
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Edited by
N.R. Rajagopal
CSIR, New Delhi

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BASIC DATA

National Laboratories/Institutes	...	35
Industrial Research Associations	...	2
Extension Centres/Field Stations etc.	...	71
Scientists	...	4531
Other scientific and technical staff	...	9171
Administrative staff	...	4877
Research Committees	...	12
Research schemes in progress	...	522
Emeritus scientists	...	21
Pool scientists	...	317
Research fellowships	...	4100
Processes released to industry	...	61
Processes that have gone into production	...	34
Patents filed in India	...	117

Budget for 1980-81 (Rs. in million)

	Sanctioned estimates	Revised estimates	Finally modified estimates
Plan	256.400	263.080	262.897
Non-Plan	345.107	353.547	348.547
Total	601.507	616.627	611.444

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)
Indian Institute of Petroleum, Dehra Dun	(IIP)
Central Fuel Research Institute, Jealgora	(CFRI)
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 Chemical Biology, Calcutta [formerly Indian Institute of Experimental Medicine (IIEM)]	(IICB)
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)
ENGINEERING SCIENCES	
Central Building Research Institute, Roorkee	(CBRI)
Central Road Research Institute, New Delhi	(CRRI)
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 & Roorkee	(SERC-M), (SERC-R)
Regional Research Laboratory, Bhubaneswar	(RRL, Bhu.)
Regional Research Laboratory, Trivandrum	(RRL,Trivandrum)
INFORMATION SCIENCE	
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)

CONTENTS

Introduction	1
Research Utilization at a Glance	2
Resource Development	3
Electronics (Materials, Devices) and Instrumentation	6
Chemicals (Including Metals) and Chemical Engineering	9
Post-Harvest and other Agro/Bio-technologies	19
Energy	25
Machinery Development	26
Surveys & Analyses	28
Dissemination of Information	32
International Symposia	34
Centre for the Study of Science, Technology and Development	35
Training Courses	37
Other Activities	39
Basic Research	40
General	55
Honours & Awards	59
Financial Data	62
Non-plan—Sub-headwise Breakup of Actuals	63
Plan—Sub-headwise Breakup of Actual Expenditure	64
Appendix I—Processes that have gone into Production	66
Appendix II—Processes Released to Industry	69
Appendix III—Patents/Applications Filed, Accepted, Sealed in India and Abroad	73

INTRODUCTION

Beginning with the year 1977-78, the Annual Report of CSIR has been presented in a comparatively concise form highlighting the contributions that the national laboratories have made to the different sectors of economy. This has been generally welcomed all round.

It has also been recognised that the national laboratories have been offering a wide range of technical services, consultancy and advice to the industries in the country in general. It may not be out of place to mention here that what is reported is the culmination of years of scientific work conducted in the laboratories and there are several important programmes underway. Some of them do not find a mention in the report only because they have not yet reached the stage of transfer to the user or the beneficiary. Yet, the Council having been established as the premier organization for scientific and industrial research, it is necessary to take stock of its contributions in terms of the knowledge it has generated and its achievements in different areas of science and technology. After all the large infrastructure that has been built over the years should be utilized for the general advancement of science. Hence in this report basic research has been given adequate importance and the contributions of national laboratories — scientific and technological — have been reported in respect of either the principal area of thrust or the field of science, as the case may be. Such a presentation will, it is hoped, give one an insight into the direction in which CSIR is moving. It will also help identify the areas which need augmentation in terms of expertise and those where there is scope for extension of activities.

Suggestions for the improvement of the Report, both in form and content, are welcome.

RESEARCH UTILIZATION AT A GLANCE

During the year, 34 new processes went into production (Appendix I) and 61 processes were released to the industry for the first time (Appendix II). The total number of processes released to the industry till the end of the year was 1293; of these, 570 processes were reported to be in production.

Pilot plants for the production of potassium schoenite (CSMCRI), sodium alginate from seaweeds (CSMCRI), citrus juice concentrate (CFTRI), miltone (CFTRI) and terpineol from turpentine oil (NCL) have been set up in Burma for the Central Research Organization, Rangoon.

Rs. 98.64 million was the contract value of the 633 sponsored research projects undertaken during the year in the CSIR laboratories. Of these, 231 projects were completed.

The laboratories had 347 consultancy assignments valued at more than Rs. 9.70 million. One hundred and fifty eight assignments were completed.

Patents

During the year, 117 patent applications were filed. Thirty seven patents were accepted and 24 patents sealed in India (Appendix III). One patent was filed and two were sealed abroad.

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

(Rs. in lakh)

	1978-79	1979-80	1980-81
Premia	4.112	5.758	4.120
Royalties	37.933	46.873	56.912
Total	42.045	52.631	61.032

RESOURCE DEVELOPMENT

Minerals

Polymetallic (manganese) nodules have been collected by NIO under a programme of exploration of deep-sea mineral deposits in the Indian Ocean. NIO's *R V Gaveshani* collected the first sample of polymetallic nodules during its 86th cruise from a depth of 3.6 km on 26 January 1981.

The nodules contain nickel, copper and cobalt, besides manganese and iron. India is the seventh country in the world to have developed capability to collect polymetallic nodules from deep-sea floor, the other countries being USA, UK, USSR, Japan, West Germany and France.

Encouraged by the results of this survey, the NIO scientists are planning to extend the survey of nodules to other areas in the Indian Ocean, especially the central Indian Ocean, where large areas are reported to be carpeted with high-grade polymetallic nodules.

A major programme of exploratory mining has been drawn up in collaboration with the Department of Ocean Development.

Two drilling rigs, costing Rs. 15 million each, have been gifted to NGRI by the Federal Republic of Germany, under a bilateral scientific collaboration agreement. The 'Failing 3000 CF' is a rotary rig designed for drilling deep, large diameter commercial wells; it is capable of drilling up to 12 in. diameter holes to 3000 ft. depth. The rigs have a two-stage mast reaching up to a height of 58 ft. and can be modified to drill telescopic holes of 6 to 12 in. diameter. Using these rigs, NGRI, in collaboration with the Central Ground Water Board (CGWB) will organize a six year ground water exploration programme in some districts of Tamil Nadu, Andhra Pradesh, Kerala and Mahanadi delta of Orissa. Drilling operation of the first rig was inaugurated at Puduvayal in Chinglepet district of Tamil Nadu and that of the second rig in Peddapuram village in East Godavary district, A.P. NGRI and CGWB will jointly organize the drilling operations.

RRL (Bhubaneswar) has completed a project on beneficiation of low grade siliceous chromite from Boula region, sponsored by M/s Ferro Alloys Corporation Limited (FACOR), A.P. Based on this technology, the sponsor is planning to set up shortly a commercial plant in Orissa for the beneficiation of such ores. Investigations were carried out on the beneficiation of low grade ferruginous chromite with low silica from Sukerangi area, Orissa. This was sponsored by M/s Orissa Mining Corpn., Bhubaneswar. It is expected that the sponsor may set up a commercial plant based on the results obtained in the laboratory.

A new method for *in situ* degasification of coal seams using bacteria has been tried by CMRS at the New Ghusick colliery of the Eastern Coalfields Ltd., and Bhatdee colliery of Bharat Coking Coal Ltd. Methane emission rate from two development headings of the New Ghusick colliery was reduced from 87 m^3/min to 0.35 m^3/min in 13 days after bacterial injection. At the Bhatdee

colliery, bacterial infusion in an area led to the reduction of methane emission from 0.61 m^3/min to 0.1 m^3/min in 56 days.

At the Swang colliery of the Central Coalfields Ltd. (CCL), two existing hydraulic stowing plants have been reorganized by CMRS after detailed scientific investigations. In both the cases, the rate of stowing has been improved from the existing 20 tonnes/hour (tph) to nearly 100 tph. The stowing cycle of this longwall face has been decreased from one month to 5-6 days bringing in considerable saving in manpower and pumping cost. About three weeks of extra time is thus available for carrying out normal coal production operation.

A concrete mat has been designed and successfully employed by CMRS in an experiment at the Setwa mica mine in order to replace the crown pillar. During stowing operations in steeply dipping mica mines, complete extraction of mica ore is not possible and about 20 per cent of mica is lost in the crown pillars. The design of a concrete mat would help in preventing such loss of mica. The mat consists of a main bar and a bent up bar of 12 mm diameter spaced at 20 cm using cement, sand and gravel in the proportion 1:2:4.

Ceramic Materials

Modern technology for making glazed wall tiles requires costly raw materials which are highly energy intensive because of the higher firing temperature. Glazed wall tiles of varying pleasant shades with adequate crazing resistance have been produced by CGCRI using locally available common red clays and Gangetic silt along with glazes at a lower firing temperature (950°C). The technology is simple and is specially suited to the small scale sector. Further improvements in the body and glaze compositions are being made.

The process for making synthetic mullite refractories and mullite-corundum aggregates containing up to 80 per cent alumina and suitable for use in industrial furnaces, stoves, hot zones of tunnel kilns, sintering zone of rotary cement kilns, chequer work, etc. as well as in glass industry was assigned by CGCRI through NRDC to Kumardhubi Fire-clay and Silica Works Ltd., a prominent refractory plant in Bihar. Pilot scale production has been started by the firm with technical assistance from the Institute.

Process know-how for the production of nitride-bonded silicon carbide (Patent No.701/Del/79) was developed by CGCRI. Silicon carbide refractories are widely used as bricks, tiles, crucibles, kiln furniture, muffles, recuperator tubes, etc. in metallurgical, ceramic and other industries. Such refractories produced in India have an alumino-silicate bond which weakens at high temperature causing failure of the refractories. Nitride-bonded silicon carbide does not lose strength even at 1600°C; in fact its high temperature strength is higher (9000 psi) than the room temperature strength (6000 psi). The cause for increase in strength at higher temperature was also investigated. It is immune

to corrosion by most metals and fluoride baths and has a remarkable thermal shock resistance. The nitride-bonded silicon refractories were tested as kiln furniture with very satisfactory results.

One of the major problems of the pottery industry in India is the poor performance of saggars. Generally, the life of a saggar is only 4 to 6 firing cycles; this adds to the cost of production of the ceramicware fired in them and also affects its quality. CGCRI has developed cordierite-based saggars, using a suitable mixture of preformed cordierite and clay. These saggars have been tried in a producer gas-fired tunnel kiln and an oil-fired down draft kiln. In both the trials, the saggars withstood more than 40 firing cycles. The process has been referred to NRDC for commercial utilization.

Water Treatment

Andhra Pradesh is the fourth State in India to receive the technical assistance of NEERI for the design and construction of a slow sand filtration plant at Pothunuru village, 75 km from Vijayawada in the West Godavari District. The plant built at a cost of Rs. 5.5 lakh provides treated water to 4500 residents of Pothunuru. The major share of the construction cost was borne by the Government of Andhra Pradesh and the balance was provided by NEERI from funds received from WHO, IRC, the sponsor of this international collaborative project. The primary purpose of this project is to demonstrate the suitability and appropriateness of slow sand filtration under different local conditions and to promote its large-scale application in India, especially in rural areas for the treatment of surface waters. Three other states where SSF demonstration plants have been commissioned under this project are Haryana, Maharashtra and Tamil Nadu.

ELECTRONICS (MATERIALS, DEVICES) AND INSTRUMENTATION

At the request of the Railway Design & Standards Organization (RDSO), (Ministry of Railways), Lucknow, a project for the development of single phase-to-three phase converter for replacing the rotary converter used on WAM 4 locomotive was initiated at CEERI, as a sponsored research programme in 1974.

The first prototype of the inverter was tested for satisfactory performance on a static locomotive in January 1977. Subsequently, several tests were carried out by RDSO and CEERI, so that the equipment could be finally incorporated in the complete system of WAM 4 locomotives. Based on the suggestions of RDSO, engineering modifications were carried out from time to time on the first prototype and as per recommendations of the Review Committee, a Model Al of the converter was fabricated and subjected to detailed trials on full load in the Ghaziabad Electric Loco Shed. In a parallel path, one of the WAM 4 electric locomotives (No.20462) was modified by the Indian Railways for incorporating the CEERI equipment.

During the first week of January 1981, locomotive No.20462 was fitted with the CEERI converter and after successful tests with full load, it was subjected to runs from Ghaziabad Loco Shed to Khurja junction at speeds varying from 15 kmph to more than 115 kmph. The output voltage of the inverter was well within limits, staying between 390 and 400 volts.

The RH-560 rocket launched successfully by the Indian Space Research Organization on 1 October 1980 from the Sriharikota Range (SHAR) carried three instruments—(i) Proton energy detector, (ii) Electron energy detector, and (iii) RF electron temperature probe—designed by NPL.

Recommendations were made by NPL to the Indian Air Force about the suitability of prospective locations for installation of surveillance radars.

With UNDP assistance, CEERI has recently installed a sophisticated Pattern generator (PG) and Image-repeater (IR) combination machine manufactured by Electromask, Inc. of USA. This will be the heart of the new mask-making facility planned to meet the challenge of the ever-increasing complexity and diminishing dimension of semiconductor ICs. The Electromask's model "250 PG & IR Combo-machine" comes with a special environmental chamber to provide very close control over the operating temperature and humidity. The machine is completely computer-controlled and is capable of generating nearly 2.5 μm size patterns directly with the pattern generator with a further 10 X reduction at image-repeater station with nearly 0.3 μm absolute positioning accuracy over a 5 × 5 sq. in. area.

Instrumentation

Cryoprobe, using N_2O/CO_2 developed at NPL, which has been effectively used for treatment of cataract and retinal disorders, etc. has also been tried for treatment of tumours. However, one of the major difficulties encountered is its

low destruction capability. A number of basic studies were undertaken to increase substantially the refrigeration capacity of the NPL-developed machine, without sacrificing the tip temperature, and the new machine developed by the laboratory gives 6-8 times more cooling capacity at −80°C. Initial trials conducted at the Sir Ganga Ram Hospital, New Delhi, both on cancerous and non-cancerous tumours have given encouraging results.

A Minicardioscope, to enable instant diagnosis in cardiac emergencies, has been designed and developed by CSIO. It takes the ECG within a few seconds of placing it on the patient's chest. The instrument provides a new diagnostic concept with a portable, cordless, battery-operated electro-cardioscope with integrated electrodes for direct application on the patient's thoracic region. It was put on extensive clinical trials at the Post-graduate Institute for Medical Education and Research (PGI), Chandigarh and its operation was found satisfactory. The know-how has been assigned to NRDC.

Cardiotocograph, a sophisticated ultrasonic instrument for displaying and recording foetal heart rate and labour activity, developed last year at CSIO, has successfully undergone extensive clinical trials at PGI, Chandigarh and its know-how has been assigned to NRDC.

Design and development of the laboratory prototype of the temperature indicator for type K thermocouple was completed by CEERI. The instrument has been made in modular form consisting of five modules: power supply module, instrumentation amplifier and analogue-to-digital converter module, digital linearizer module, display module and cold junction compensation module. Linearization calculations for type R thermocouples were carried out according to the novel method devised. The linearization conformity is ±0.5°C by choosing twelve segments.

The DC Earth Resistivity Meter developed by NGRI is being manufactured by M/s Elico Ltd., Hyderabad under a non-exclusive licence through NRDC. During the year, 5 meters were produced.

Technical know-how for production of Proton Procession Magnetometer and Shallow EM Prospecting unit has been transferred by NGRI to M/s Geo Instruments, Hyderabad under the agreement reached between the firm and NRDC.

CSIO has achieved a breakthrough towards harnessing solar energy by developing indigenous technology based on replication process for Fresnel lens master fabrication. This technology has been found both functionally and economically viable. Two masters conforming to the requirements of overhead projector and solar concentrator have been successfully completed. The need for Fresnel lens as solar energy concentrators was brought to the notice of CSIO by CEERI, for the DST sponsored project on the development of solar cells.

This year, the Service and Maintenance (S&M) Centres of CSIO repaired

about 2277 instruments valued at approximately Rs. 303 lakh and earned service charges around Rs. 10.83 lakh. Repair of old instruments is often a challenging task, as spares and replacement components are either difficult to procure, not available or are obsolete. Often solutions are found by redesigning some of the circuits using available components. For the repair of instruments that cannot be transported and need attention at site, mobile servicing is being rendered by the Delhi Centre.

CHEMICALS (INCLUDING METALS) AND CHEMICAL ENGINEERING

Drugs and Intermediates, Pharmaceuticals, Pesticides and Other Chemicals

Enfenamic acid (N-β-phenylethyl anthranilic acid) is a potent non-steroidal anti-inflammatory and anti-rheumatic drug. Extensive animal studies have shown that its anti-inflammatory action is possibly related to its anti-prostaglandin action. Toxicological studies indicate that Enfenamic acid has a wide margin of safety even on long term administration. Extensive clinical trials have confirmed its anti-inflammatory action in rheumatology and soft tissue inflammatory conditions. It has excellent gastric tolerance and has no toxic effects on vital organ systems. After getting clearance from the Drugs Controller (India) the drug is being produced and marketed by M/s Unichem Laboratories Ltd., Bombay, under the propietary name 'TROMARIL' on the basis of know-how developed by RRL(H). Sales in four months touched approximately Rs. 1 crore.

Glyoxal is a highly reactive dialdehyde used in the manufacture of textile auxiliary resins and the drug intermediate methyl imidazole. The entire requirement of the chemical (about 2,000 tpa) is being met through imports. Based on the process know-how and basic engineering package provided by RRL(H), two units, M/s Manish Organics India Ltd., Ankaleswar, and M/s Rajasthan Glyoxal Ltd., Udaipur, have gone into trial production. The Laboratory scientists have helped in the commissioning of the plants. The product has gained acceptance from the major consumers of glyoxal.

A method for the production of tallow-like fat from castor oil by a single step process has been developed and released by RRL(H) to NRDC for commercial exploitation. This can replace imported tallow for soap making. A patent on this process has been filed.

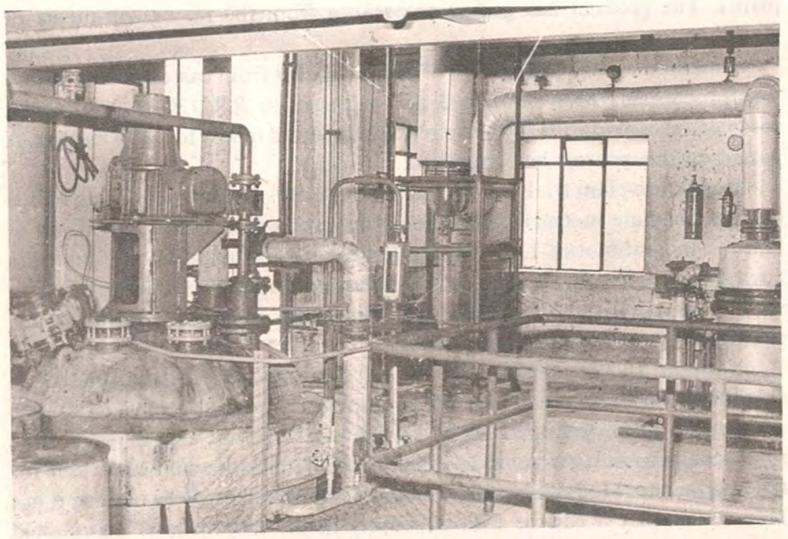
Production plant trials for the manufacture of 6-amino-penicillanic acid, a key intermediate in semisynthetic penicillin production, were carried out at Hindustan Antibiotics Ltd. (HAL), Pune with the immobilized penicillin acylase system developed at NCL in collaboration with HAL. The production scale runs confirmed the reuse potential and efficiency of the system established earlier in pilot plant trials.

A simple and convenient method for the isolation of vinblastine as its sulphate from the leaves of *Vinca rosea* has been worked out by NCL. The process has been optimized on 40 kg per batch. About 1 g. of vinblastine sulphate can be isolated from 5 kg of the leaves. Vinblastine sulphate is used for the treatment of Hodgkin's disease and other lymphomas. Very recently it has been found that it can be used effectively in the treatment of rheumatoid arthritis. A method for converting vinblastine to vincristine is now being worked out. Vincristine is a life-saving drug specifically used in the treatment of children's leukaemia.

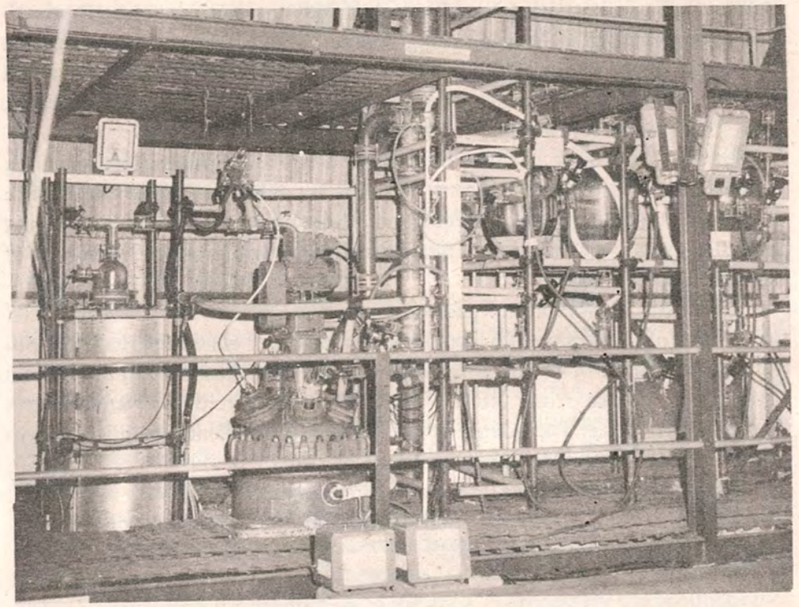
M/s Bharat Pulverising Mills Pvt. Ltd., Bombay have commissioned a 400 tpa plant for the production of endosulfan at their factory on Thana-Belapur Road, based on NCL know-how. Endosulfan is a widely used broad spectrum insecticide for many vegetable and food crops. Assistance for commissioning of the plant was provided by NCL. The annual value of production of endosulfan from this plant would be around Rs. 4 crore.

A 100 tpa pilot plant for the production of methyl chlorosilanes (based on NCL know-how) was installed and successfully operated by M/s HICO Products Ltd., Bombay at their site in collaboration with the laboratory. The design of the reactor had been prepared by NCL and its performance has been highly satisfactory. NCL will now undertake work on the design for the reactor of 1000 tpa capacity.

Quinapyramine sulphate and chloride (QSC) is a vital drug used in the treatment of trypanosomiasis which is a fatal disease affecting domestic animals like cows, buffaloes, horses, camels, dogs, etc. The NCL process for the production of QSC has been successfully demonstrated to M/s Chintamani Fine Chemicals, Pune. The product made by the NCL process has been subjected to extensive field trials and has been found to be acceptable. M/s Chintamani Fine Chemicals hope to commence production of this drug early



A view of the endosulfan plant of M/s Bharat Pulverising Mills Pvt Ltd, Bombay showing the reactor section. The plant is based on NCL, Pune know-how.



Chlorfenvinphos pilot plant of RRL (Jorhat).

next year. The requirement of this drug is about 10 tpa, valued around Rs. 2 crore.

The NCL process for a new zeolite catalyst was successfully demonstrated to M/s Associated Cement Co. Ltd. (ACC), Bombay. The isomerization of xylenes has been studied at pilot plant level using catalysts synthesized at NCL. Based on these studies, a package proposal for a catalyst and process for the isomerization of xylenes has been submitted for possible commercialization at the Indian Petrochemical Complex Ltd., Baroda.

A laboratory scale process for the production of polyphenylene sulphide, a rapidly emerging engineering plastic, has been developed.

The National Organic Chemical Industries Ltd. (NOCIL), Bombay entered into a comprehensive engineering consultancy agreement with RRL(Jorhat) for setting up an integrated plant for the production (100 kg/batch) of Chlorfenvinphos, an effective pesticide against soil insects, root flies, root and cut worms, colorado beetle on potato, stem borers on maize, sugarcane and rice and leafhoppers on rice. The agreement included demonstration of the scaled up process know-how for generation of 300 kg. of technical Chlorfenvinphos for consumer acceptability studies, preparation of basic

design package for a commercial plant of 600 tpa and providing (optimal) design engineering assistance during commercial production. An integrated semi-commercial plant of 100 kg/batch capacity set up at RRL(Jorhat) would provide data and basic designs for a commercial unit of 600 tpa capacity, NOCIL plans to set up the commercial plant in Maharashtra.

Process know-how package on tartaric acid from tamarind leaves along with the demonstration data was released by RRL(Jorhat) to Karnataka Tartrates, Bangalore. The entire demand of the country (over 500 tpa) is being met through import. In the first phase, the factory will produce 100 tonnes of tartaric acid per annum.

A 660 tpa beta-naphthol plant (cost over Rs. 1.3 crore) based on CFRI know-how of conversion of byproduct naphthalene of coke ovens has been put on stream in Bokaro. The plant has been set up by M/s Eastern Naphtha-Chem Ltd. under licence from NRDC which also supported the venture with financial assistance. The quality of the product is excellent. Modifications to reduce the cost of production are underway.

Optimal conditions have been standardized on pilot plant scale by RRL(H) for the preparation of tristearin and stearic acid by simultaneous dehydration and hydrogenation of castor oil.



A view of the 660 *tpa beta-naphthol plant set up at Bokaro based on CFRI, Dhanbad technology.*

A bench-scale process has been developed by CSMCRI to extract liquid wax from jojoba seeds and obtain lubricating oil after its sulphurization.

At the request of the small-scale slate industry, concentrated in Markapur in Andhra Pradesh, paints based on cashewnut shell liquid (CNSL), suitable for coating tin slates as well as off-colour stone slates were developed by RRL(H). The process has been released to two parties and a demonstration is being planned for the benefit of slate manufacturers' association.

The new cervical dilator (Isaptent I), which was developed by CDRI, is now under production by Unichem Laboratories Ltd., Bombay and is being marketed under the trade name Dilex-C. The device is made from the indigenously available Isapgol seed husk, and is better and cheaper than the imported "laminaria tent" presently used as an aid in medical termination of pregnancy. A second generation quick-swelling dilator (Isaptent II) has been developed and provides the desired degree of dilatation of the cervix in 5-6 hours as compared to 10-14 hours with Isaptent I. Efficacy trial of Isaptent II has been successfully completed in about 1000 cases and the Drugs Controller (India) has given marketing permission.

A process for the production of primaquine, the only drug available for treatment of relapses in malaria, starting from panisidine, was handed over by CDRI to the sponsor, I.D.L. Chemicals, Hyderabad, after establishing the optimal parameters for production of the drug. A process for the production of bumetanide (diuretic) from *p*-chlorobenzoic acid was completed and released to the sponsor, Kembiotic Collaborators, Bombay. The process for sulphamethoxazole (antibacterial) was demonstrated to Dolphin Laboratories Ltd., Calcutta. Work on the processes for metronidazole (antiprotozoal), starting from 2-methyl imidazole, and for trimethoprim (antibacterial), both sponsored by Unichem Laboratories Ltd., Bombay, has been completed.

The process of RRL(Jammu) for the production of gibberellic acid by submerged culture was transferred to M/s Chemosyn Pvt. Ltd., Bombay.

RRL(Jammu) process for the production of hydrogenated rosin and disproportionated rosin was released to M/s Prabhat Terpenes and Synthetics (P) Ltd., Jammu. M/s Suket Chemicals (P) Ltd., Sundernagar (H.P.) were given technical know-how for the production of rosin derivatives.

Under the NRDC-ITEC (Indian Technical Economic Cooperation) Programme, an integrated pilot plant for the production of terpineol, a perfumery chemical, was designed, erected and commissioned by NCL in collaboration with MERADO, Pune. The pilot plant has been exported to the Central Research Organization, Rangoon. The pilot plant fabricated at a cost of Rs. 10 lakh has been designed to produce 19 kg/batch of terpineol starting from turpentine oil. NCL design engineers will help Burma in commissioning the plant. This is the first technology to be exported by NCL to a foreign country.

An anti-corrosive treatment process for reinforcing steel, developed at CECRI and licensed to Maharashtra PWD, is now being utilized in the construction of the 809.2 m long Kashali Creek Bridge near Thana. The process will be used for treating approximately 1000 tonnes of steel used in Kasheli and Kalwa bridges. It will also be used in several other bridges to be constructed along the coast in Maharashtra.

Metals and Metal-forming Techniques

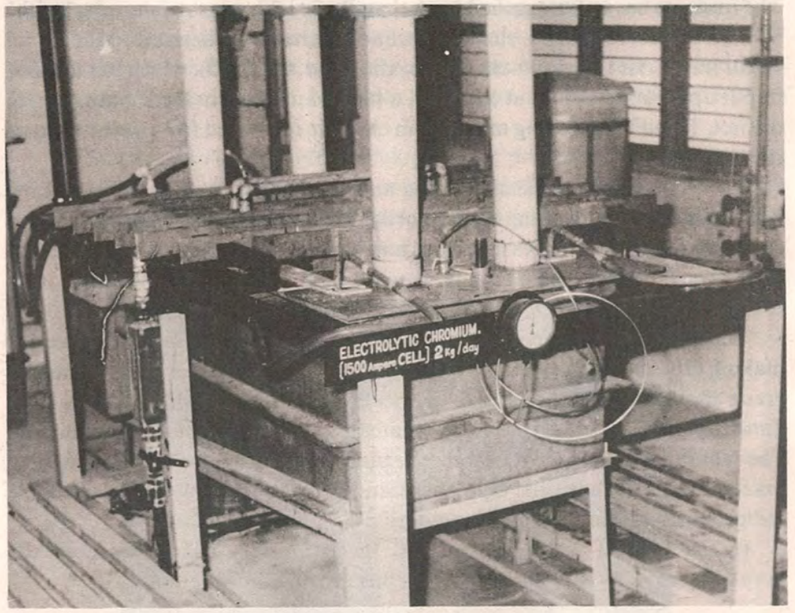
NML has accepted a package deal for setting up a 1 tonne per day pilot plant for the production of ferro-tungsten by alumino-thermic reaction for the Central Research Organisation, Rangoon, Burma. The assignment was given through NRDC under the Indian Technical & Economic Cooperation Programme.

NML has developed PM 401 aluminium alloy-bearing bushes as substitute for bronze bearing bushes and supplied them to RDSO for evaluation. RDSO fitted these bushes to steam locomotives. Their performance was evaluated under actual running conditions and was found satisfactory. Further field trials are in progress.

To counteract problems of severe corrosion in the coastal regions, the Gujarat State Electricity Board (GSEB) installed two types of conductors made of the versatile electric grade aluminium alloy 'NML PM2.' Encouraged by the good performance of the conductor, GSEB and the Central Board of Irrigation and Power jointly convened a conference at Baroda on 13 April 1981 of representatives of all the State Electricity Boards having coastal regions to serve and a decision has been taken for wider trials with a composite ACC NML-PM2 and PM 215 conductor in the coastal regions. NML-PM 215, a high strength (30 kg/mm^2) and medium conductivity (53% IACS) alloy is in an advanced stage of development.

Under three collaborative programmes of work with Visvesvaraya Iron and Steel Limited on process standardization for the production of high strength low alloy steels, industrial scale heats of niobium and niobium-vanadium steel were made in a 12 tonne L D converter. These steels are used in the construction of ships, bridges, buildings, pressure vessels, pipelines, wagons, reinforcement rods, transmission towers, etc. It is an import substitution product, since India is still meeting its demand partially through import.

To minimize the rate of rejection in aluminium utensil manufacture, NML has rendered expert and consultancy services to the small scale utensil manufacturers in Bihar. With the assistance of NML, the rejection rate was brought down to 5-7 per cent as compared to the present rate of 25-35 per cent. A workshop-cum-get-together was organized at Patna where the NML developed technology was demonstrated.



Electrolytic cell for the production of chromium metal set up at RRL, Bhubaneswar.

RRL(Bhubaneswar) has undertaken a collaborative project with M/s Kalinga Iron Works, Barbil, Orissa on the production of heat hardened agglomerates. In this project, iron ore fluxed sinters have been produced continuously in the pilot plant set up at their plant site. By charging these sinters along with lumpy ores into their low shaft furnace, it has been possible to decrease the coke rate and increase the production of pig iron considerably.

RRL(Bhubaneswar) has successfully completed a sponsored project to produce electrolytic chromium powder from chromic acid. In this project, bright chromium metal was converted into flakes which can be ground to produce chromium powder of 99.9 per cent purity. It is estimated that a plant (120 tpa) based on the process will require a capital investment of Rs.65 lakh approximately. The final report in this regard has already been submitted to the sponsor.

CECRI has developed technology for the production of electrolytic magnesium metal under a project sponsored jointly by the Tamil Nadu Government and CSIR. This process is versatile, since it can employ different types of raw materials like magnesite, carnallite, dolomite, sea bitterns and byproduct magnesium chloride obtained from zirconium and titanium plants.

The Institute has so far supplied more than Rs.20 lakh worth of the metal to the Mint, Defence, foundries, etc. This technology has been licensed to the Tamil Nadu Industrial Development Corporation Ltd. (TIDCO), which has decided to put up a 600 tpa plant at Mariyur, a backward place in Ramanathapuram district, Tamil Nadu, using magnesium chloride recovered from sea bitterns as raw material.

The pilot plant for metal forming and material synthesis at NPL is now fully operative and working satisfactorily. The pilot extruder has been used to extrude a number of shapes in ferrous and non-ferrous materials. Of particular interest are copper-clad aluminium wire, bar, and gear shapes and other profiles in copper and steel.

The shear spinning technology developed at NPL is a powerful device for making tubes in hard materials. Experiments on stainless steel and commercial grade titanium have shown that the technology is capable of making high dimensional tolerance tubes in these materials and can be put into production. The laboratory is now working on the indigenous design of a shear spinning machine, so that both the equipment and process technology are available indigenously for commercial exploitation.

In the field of material synthesis, the laboratory has commenced the development of W-BN compacts. Further work is in progress.

Chemical Engineering, Process Design

CSMCRI has designed and developed an economical water softening unit based on the continuous counter-current ion-exchange technique. Providing, as it does, a continuous supply of soft water, the process is more economical than the lime soda process and the conventional fixed bed ion exchange process both of which are widely used commercially. A successful demonstration of the working of the continuous counter-current ion-exchange water softening plant was held recently at Botad railway station, Western Railways.

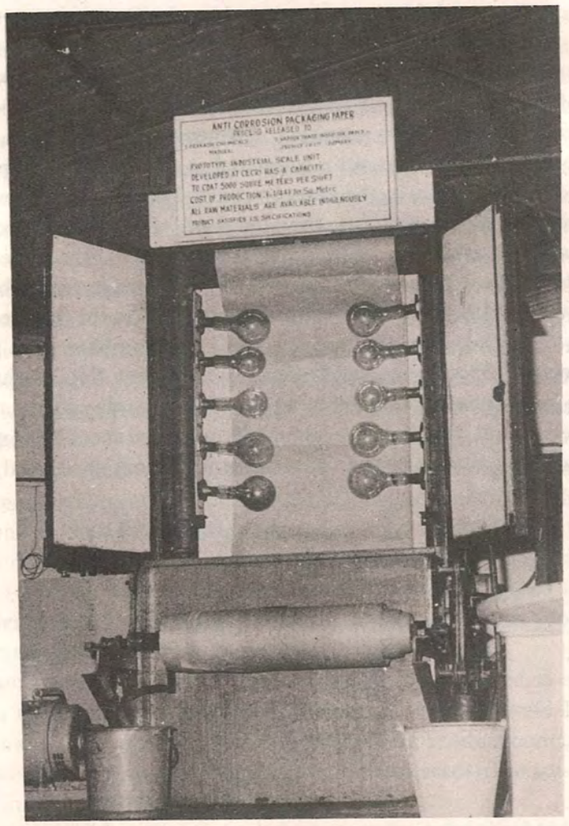
A collaborative research project of M/s Balmer Lawrie Company Ltd., Calcutta and CLRI for scaling up of processes developed already at laboratory scale for the production of a range of synthetic fatliquors has been taken up during the year. This project involves payment of Rs.6.25 lakh by Balmer Lawrie to CLRI.

Walnuts to the tune of Rs.7 crore per annum are exported from J&K State. In order to improve the shell appearance, these are bleached. The conventional method is defective and cumbersome and renders the kernel prone to fungal attack. A bleaching formulation and a processing plant have been developed and released to two leading walnut processing units in Jammu.

Sponsored by the Petroleum Processes Development Coord. Group (PPDCG), an IIP pilot plant for the development of a solvent deoiling process was commissioned in December 1980 with the assistance of Engineers India

Ltd. Performance runs are in progress to develop process and engineering know-how for wax deoiling. The other major work in the PPDCG programmes is development of 'Visbreaking' process. A decision has been taken to add 'Delayed Coking' facilities to this unit and process design for this has been done.

IIP continued to work on the development of processes for petrochemical intermediates and additives. Petroleum sulphonate samples developed for the secondary and tertiary recovery of crude oil from wells were found promising



Coating machine for production of anti-corrosion packaging paper designed and fabricated at Central Electrochemical Research Institute, Karaikudi.

after trial on core samples by the Oil and Natural Gas Commission. Further field trials are planned.

Paper and Paper Board

R&D efforts at RRL(Jorhat) to produce paper and boards from water hyacinth (*Eichhornia crassipes*) have yielded successful results. Good quality papers, boards and grease-proof papers have been produced from this aquatic weed in the course of investigations at the laboratory.

RRL(H) has started pilot plant production of paper board from water hyacinth. Facilities have been established for the processing of 200 kg of wet material/day. This work has been sponsored by the Commonwealth Science Council.

Anti-corrosion packaging paper is used for the prevention of corrosion of all types of ferrous items and engineering stores, such as components of bicycles, sewing machines, typewriters, refrigerators, small arms, etc. The value of the demand for this paper is estimated at about Rs.1 crore per annum and is expected to increase in the years to come. The inhibitive chemicals are dissolved either in water or a solvent and the paper to be coated is treated with this solution by roller coating technique in such a way that the coated paper is also dried during travel. The coated paper is later wound in rolls. This process know-how was satisfactorily demonstrated by CECRI to the representative of Vapour Phase Inhibitor Paper Products Co. Ltd., Bombay.

At the request of the Arunachal Pradesh Government, RRL(Jorhat) agreed to assist the Industries Department to set up a 300 sq. ft/day corrugated paper roofing sheets unit at Pasighat. The laboratory provided specifications of plant and machinery, assistance in their procurement, factory shed, trial runs and training of personnel.

POST-HARVEST AND OTHER AGRO/BIO-TECHNOLOGIES

Post-harvest Technologies

The task of commissioning an orange concentrate plant in Burma (2 tonnes of orange/shift, designed by CFTRI and fabricated in India), under the NRDC programme, has been completed. The plant can be used for the production of single strength pasteurized juice, concentrate, squash and cold processed peel oil.

A manufacturing unit for miltone (animal milk toned with groundnut protein) has been set up in Burma under a task assigned by NRDC. The plant which was designed at CFTRI and fabricated in India was installed and commissioned in Burma. The personnel have also been trained to operate the plant with production capacity of 5000 litres per day.

CFTRI has developed a laboratory scale process for incorporating natural essential oils into tea. An important feature of the process is that the rich flavour notes of the essential oil blend smoothly with natural tea flavour. Rose, cardamom, ginger, bergamot, orange and lime flavoured tea beverages have been prepared and found acceptable. In view of the advances made by the Institute in the development of know-how for a variety of flavoured tea beverages, the Tea Board has recently sponsored a time-bound research project for upscaling the laboratory processes for commercial use.

Under a consultancy programme of CFTRI for M/s Agro Corn Products, Bangalore, the second unit for the manufacture of energy food (the first unit commissioned earlier at Mysore is in continuous operation) has been erected and commissioned at Belgaum. This unit is scheduled to produce 500 tpa of energy food. The installation of units at Raichur and Chitradurga has been completed.

Trial production of protein chewy candies has been started by an entrepreneur in Karnataka State using CFTRI know-how. Two other units in Kerala and Andhra Pradesh are expected to be established soon. Unlike other confectionery items which contain carbohydrates, protein chewy-candies contain 15-16 per cent of vegetable protein and can be used as nutritious supplements. The total capital outlay for a unit which can produce 500 kg chewy candy/8 hour shift is about Rs.6.75 lakh.

Commercial production of cocoa mass has been started in a 200 kg/day plant set up by M/s Mysore Food & Farm Products Private Limited with CFTRI know-how and expertise. Cocoa mass is a product containing the full complement of fats, sugars and proteins of cocoa seeds. The total investment for this unit is about Rs.7 lakh.

RRL(Jammu) has been retained as consultant by the Madhya Pradesh Govt. for setting up a new multipurpose fruit preservation industry at Khandawa (M.P.).

Agrotechnologies

Five promising cultivars of foliage Amaranthus, viz., 'Amar Prithu', 'Amar Preet', 'Amar Kiran', 'Amar Tirang' and 'Amar Tetra', evolved by NBRI, evoked keen interest of the floriculturists, and were released to the nursery trade. Six grams of the seeds of each of these five cultivars are being supplied to M/s K.S. Gopalaswamiengar Sons, Bangalore, for Rs.100 per gram. While 'Amar Tetra' is of polyploid origin, the other four cultivars have been evolved through inter-verietal hybridization and selection from among Amaranthus tricolor complex.

A new selection of small Chrysanthemum named 'Sujata', was released by NBRI. It bears semispherical, compact and bright yellow blooms during November-December and is suitable for cut-flower trade.

A truly summer blooming cultivar was isolated for obtaining year round blooming without environmental control. This selection blooms during April-June under Lucknow conditions bearing bronze-yellow, semi-double Korean type flowers. A new mini-culture technique for growing dwarf cultivars of Chrysanthemums in miniature-sized pots (5-10 cm. diameter) was standardized and is particularly useful for urban flat dwellers.

As a further step towards utilization of indigenous protein and lipid-rich seed materials, samples of processed kernel meal (protein 39%) and seed meal (protein 28%) of *Madhuca butyracea* Macb., and defatted seed meal (protein 33%) of winged bean (*Psophocarpus tetragonologus* DC) were prepared and supplied by NBRI to CFTRI for toxicological studies.

A new variety of hops 'Commet' was released for commercial cultivation in Kashmir Valley. This year 85 tonnes of hops valued at Rs.65 lakh were produced in the valley using RRL(Jammu) technical know-how. Three short term training courses in cultivation of hops were conducted by the RRL(Jammu) Branch Laboratory. Clocimum (the oil of which can be used as a substitute for clove oil), released last year, has been brought under commercial cultivation in about 3.2 hectares of land in Jammu mainly to cater to the demand for its seed. Elite clones of *Dioscorea composita* were developed and 7000 rooted plants of this species were supplied to private growers in Maharashtra and N.E. India. Testing facilities and technical know-how were provided to mushroom growers of Kashmir Valley; 19000 bottles of spawn were also supplied leading to production of mushroom worth about Rs.12 lakh.

The agro-technology developed by NBRI for mass production of German Chamomile (*Matricaria chamomilla*) flowers to yield blue oil on distillation has been exploited commercially. Under an agreement with M/s German Remedies, Bombay, the crop has been raised at the Banthra Research Station over 11.00 hectares to yield 5.30 tonnes of flowers valued at over Rs.0.81 lakh. The blue oil obtained by steam distillation of flowers finds extensive use in

pharmaceutical and flavouring industries. The yield of dried flowers per ha. on an average is 1,5000 kg. This gives 5 kg. of blue oil valued at Rs.5,000,00 per kg. Chamomile possesses a high degree of tolerance to soil alkalinity and its cultivation on sub-marginal lands proves doubly gainful: (1) for the economic utilization of self affected soils, and (2) helping in the reclamation of sodium saturated soils.

Investigations carried out by CIMAP Regional Centre, Kodaikanal have indicated that it is possible to get two crops of ergot in a year. This is the first record of cultivation of two crops of ergot in a year anywhere in the world. It is generally accepted that rye can be cultivated either as a winter crop or as a summer crop, depending upon the climate. The Kodaikanal discovery will be a boon to the farmers in the Palani and Nilgiri Hills, as they can now obtain two crops of a valuable drug on the same piece of land, without much investment. The Nilgiris and Palani areas in Tamil Nadu are thus expected to become the best locations in the world for commercial production of ergot.

The Governing Body of CSIR at its meeting held on 30 September 1980 approved of the establishment of an Experimental Farm of CIMAP near Boduppal, Andhra Pradesh. Initially, citronella java, palmarosa, lemongrass, davana, *Catharanthus roseus* (L) G. Don and other economic plants would be grown. It is aimed to acquaint the marginal and poor farmers of the state with the advantages of growing economic medicinal and aromatic plants. This will result in increased production of medicinal and aromatic plants in the state possibly for export. At the same time, the farmers will also be benefited through increased farm income.

Lavender oil, produced from various species of *Lavandula*, is one of the essential oils used in perfumery and cosmetic industries. The entire requirement of the country was met through imports at an approximate cost of Rs.20 lakh per annum. The Research and Development Unit of CIMAP at Manasbal in Kashmir has been successful in the introduction of lavender on commercial scale and about 4-ha plantation has already been raised. Trials indicated that lavender oil could be produced in Kashmir Valley. This would be a boon to farmers in the valley, because it could be grown on poor soils. Lavendin, an essential oil bearing plant, has also been introduced and could be grown on such soils.

Biotechnologies

The activities of the Kanpur Centre of CLRI have enabled many small and medium scale tanners, who are hitherto manufacturing only vegetable tanned sole leather, to become manufacturers of export-grade finished leathers of various types ranging from buff calf upper leather (aniline and semi-aniline), zug-grain upper leathers to garment and fine glove leathers from sheep skins.

The Kanpur Centre actively participated in the LEFAIR conducted by the Kanpur Tanners both in the technical seminar and in the fashion parade.

The major R&D activity of the Jullundur Centre of CLRI is the development of suitable processes for making upholstry leather and leathers for leather goods from belly pieces of bag tanned leather. The popularity of zirconium and chrome zirconium combination tanned leathers for making hockey and cricket balls has encouraged many new entrepreneurs.

A turn-key job for the production of diosgenin for the Government of Tamil Nadu was completed. Chemists of Cinchona Department of the State were trained in plant operation and production technology. The total cost of the project is Rs 11 lakh. With this plant going into operation using the technology developed by RRL (Jammu) production of diosgenin in India is now of the value of Rs. 3 crore per annum. Till the late seventies this drug was being imported.

The CSIR supported Neuropharmacology Unit at K.G.'s Medical College, Lucknow, and the Clinical Pharmacology Unit at Seth G.S. Medical College, Bombay, have been taken over by CDRI with effect from 1 July and 8 December 1980 respectively. The Clinical Pharmacology Unit has been carrying out clinical pharmacology and efficacy studies of pharmacologically active compounds developed by CDRI and other laboratories. In the Neuropharmacology Unit synthesis and screening of compounds for CVS activity and basic studies are in progress.

Based on the know-how supplied by NEERI, M/s National Newsprint and Paper Mills, Nepanagar (Madhya Pradesh) have commissioned an integrated waste water treatment plant during 1980-81. The plant was set up at an estimated cost of Rs 1 crore.

NEERI has developed process know-how for the removal of sulphite from high sulphite-bearing organic waste waters emanating from the basic organic chemical industry. Removal of sulphite is a prerequisite for the biological treatment of waste water. A full-scale treatment plant for sulphite removal is being established and will be integrated with neutralization facilities that are already existing at M/s Hindustan Organic Chemicals Ltd., Rasayani (Maharashtra).

As part of a project sponsored by the Indian Telephone Industries, Rae Bareilly, ITRC examined 58 workers exposed to cyanide fumes in case hardening and electroplating processes, along with 35 control workers. Clinical examination, behavioural studies, estimation of cyanide and thiocyanate in blood and urine and routine blood examination were conducted. Monitoring of hydrocyanic acid and cyanide aerosol at work place was also undertaken as part of industrial hygiene studies. Lacrimation, itching and congestion in eyes and headache were observed in the workers. Besides skin diseases, behavioural studies revealed a significant effect on the

psychomotor ability of the electroplating workers. There was an increase in the content of cyanide and thiocyanate in the blood of exposed workers. Similar findings were made from analysis of urine samples.

A health problem referred by the Tear Smoke Unit of the Ministry of Defence, Government of India, Gwalior, was investigated. Eighty-eight workers of the unit were clinically examined for health problems caused by occupational exposure to chloracetophenone and other chemicals used for making tear gas shells. Concentration of chloracetophenone in work environment was found to be higher than the threshold limit values. Workers suffered from eye troubles, indicating conjunctivitis, chest pain and diseases of teeth and gums. Abnormal values of alkaline phosphatase were recorded in 20 per cent of the workers.

Manufacture of instant tea at the pilot instant tea factory at the Tocklai Experimental Station (TES) of TRA has made significant progress. For the first time, the product has reached the desired standard of the tea trade. If its shelf-life can be assured, it will usher in a tremendous change for the tea industry.

Recovery of instant tea chemical and the quality of the product have improved vastly. About 15 kg of instant tea prepared from coarse leaf was sent out for market evaluation.

A number of substrates for the assay of enzymes have been synthesised and made available by the CSIR Centre for Biochemicals, Delhi, an autonomous laboratory functioning under the Indian Institute of Experimental Medicine, Calcutta. A beginning has also been made for the preparation of histochemicals. A total of 20 substrates and histochemicals have been prepared for the first time and made available to bio-scientists.

A method for the isolation of carbonic anhydrase has been standardized at the Centre for Biochemicals, Delhi. Work is in progress on the preparation of *N*-acetyl neuraminic acid (NANA) and N-acetyl neuraminic lactose.

TES is the only one in the world to breed (not select) improved varieties of clonal tea seed, five of which (including Stock 462) have already been released to the industry for commercial cultivation.

Apart from seed stock 462, two more biclonal stocks are showing promise.

Nitrification inhibitors like N-serve and coated slow release urea reduced leaching loss of soil nitrogen from 60-70 per cent to 30-35 per cent. Soil build up of nitrogen is being studied by TES through the use of isotopic nitrogen.

The tea industry uses every year Rs. 20 crore worth of nitrogenous fertiliser. Reduction of leaching loss by half presages a huge saving of Rs 4 to 8 crores every year.

Production of food colour from tea waste is another significant achievement of TES, particularly when synthetic food colours are suspected to

be carcinogenic and hazardous for health. The tea based food colours have already been tested by ITRC and found to be non-toxic.

Carbonated and non-carbonated cold drinks prepared from tea are being evaluated for commercial use.

A new method has been developed by NCL for the clonal propagation of cardamom. There are wide variations in yield between different cardamom plants and tissue culture can now be used for rapid multiplication of high yielding elites. Methods have also been developed for the clonal propagation of tamarind and shoot tip cultivation of banana to obtain virus-free stock.

ENERGY

A 100 kg/hr, continuous oil agglomeration pilot unit has been set up and commissioned at CFRI. A reduction of 30 per cent in oil consumption has been achieved by using additives. A feasibility report for a 10 tph demonstration plant prepared by the Institute has been submitted to BCCL/CCWO. BCCL have now initiated action for the installation of this demonstration plant at Patherdih Washery. The 2 tph pilot plant based on CFRI technology is continuing to function at the Lodha washery of BCCL.

Bulk production of formed coke by CFRI technique using low phosphorus char (earlier made at CFRI for a different study) has been taken up for a joint project on testing the applicability of formed coke in the blast furnace of Kalinga Iron Works for special grade pig iron production. Earlier studies at IISCO foundries established the applicability of CFRI formed coke foundry practice with advantage. In the private sector formed coke plants based on CFRI technology at Calcutta and Ghaziabad are continuing their production and/or undergoing partial modification.

A solar hot water demonstration unit has been designed and installed by CSMCRI at the Jehangir Textile Mills, Ahmedabad. The first ever industrial solar hot water unit to be installed on the south sloping roof of a textile mill is likely to supply 6000 litres of hot water at 80°C.

IIP has taken up work on studying the use of alternative fuels for automotive engines and devising means for the conservation of petroleum products.

Solar cell panels of AMI rating of about 100 W have been fabricated starting from polycrystalline silicon made at NPL. Various process improvements like solderable contacts, spin-on antireflection coating, etc., have been successfully tried. In order to prepare large diameter polycrystalline silicon substrates, directional casting inside crucibles has also been tried. Substrates of up to 30 mm dia. have been prepared, which when made into solar cells, give AMI efficiency of 7-8 per cent.

During the year, CMERI investigated causes of failure of boiler tubes of the Gouripur Electric Supply under the West Bengal State Electricity Board and recommended preventive measures. The Institute also undertook reclamation of the heat exchanger evaporator of the Coke Oven and Byproducts Division of Durgapur Steel Plant. An imported heat exchanger of this type costs about rupees 15 lakh in foreign exchange. The job involved repair of innumerable leaks between the copper tubes and the plate using a low-heat input soldering technique.

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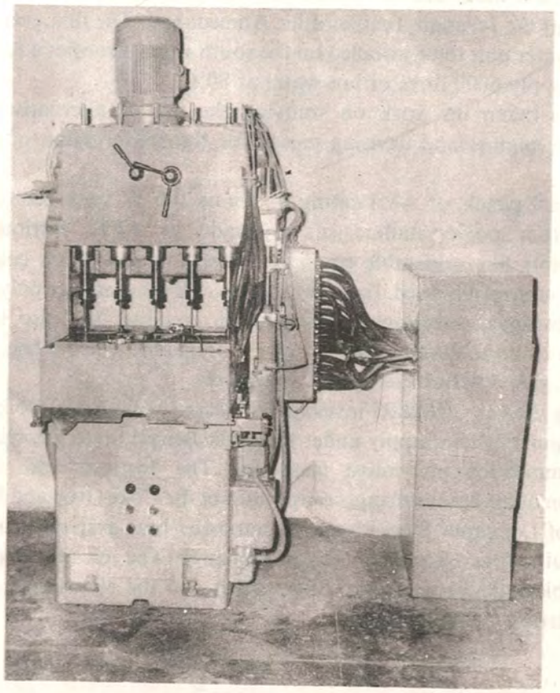
MACHINERY DEVELOPMENT

CMERI has been working on two projects sponsored by M/s Chloride India Ltd., one for design of power mixing and handling plant and the other for project engineering of a magneto-vibratory filling plant for battery manufacture. Design work for the power fixing and handling plant is almost complete, while design work for the other project has been completed. This work further involves inspection during fabrication, erection and commissioning.

MERADO, Ludhiana, has designed and developed a tractor drawn combine harvester as a sponsored project. The imported harvester combines currently in use in India are self-propelled and costly. They also remain idle for about 8 months a year. The present project aims at developing a tractor drawn harvester incorporating certain changes in the design to match local conditions. Design of the tractor drawn harvester combines has been completed and fabrication of the prototype is in progress.



Multispindle reaming machine, SPM, for reaming bores of IC engine valve guides designed and developed by Merado, Ludhiana.

MERADO, Ludhiana, has also developed an automatic reaming machine for reaming of bores of valve guides in vertical position. The design of the machine incorporates optimum parameters essential for attaining the maximum required surface finish. The machine has an automatic cycle for reaming, locating, clamping, declamping and linear indexing of fixtures slide. Prototype testing has been carried out successfully.

As an import substitution item, MERADO, Ludhiana, has developed a versatile single spindle automatic turret lathe, with provision for six or eight station turret. It has five transverse slides including a compound slide at the rear and a separate swing type bar stop. The machine can be equipped with eleven different tools, six of which can operate simultaneously to perform any of the desired combination of operations, i.e. turning, drilling, boring, reaming, tapping and threading, facing, parting and grooving. Provision exists for adjusting angular position of the cam in steps of 20 and the cam rise to tool traverse ratio in a stepless manner. The sponsor of the project has already taken up its manufacture.

The project on development of design drawings for machines for tanning leather goods and footwear sponsored by the Andhra Pradesh Heavy Machinery and Engineering Ltd., Hyderabad and undertaken by CLRI is continuing.

NAL has developed a fibreglass epoxy resin impregnating tape manufacturing machine 'GRIM' for Hindustan Aeronautics Ltd., Bangalore. The machine has been designed to produce unidirectional composite tapes at the rate of 6 metres per minute, to facilitate fabrication of helicopter blades and various fighter aircraft components. This would help the industry in developing components, which was not possible hitherto.

NAL has also developed a brake pad material friction test rig for Hindustan Aeronautics Ltd., Hyderabad. These rigs are used to carry out acceptance tests for frictional properties on ready-to-use brake pads used in high energy braking systems, such as in aircraft.

NAL has successfully designed and fabricated a 240-tonne electronic weighing system for the rotary wagon tippler built by the Heavy Engineering Corporation Limited (HECL), Ranchi. The system was installed at the Coal Handling Facility, of which the tippler is a part, of the Bongaigaon Thermal Power Station, Salakati in Assam. A unique feature of the weighing system design is that it can be incorporated into an existing wagon tippler of HECL without structural alterations.

SURVEYS & ANALYSES

The work carried out under the Resource Quality Assessment Programme at the seven Coal Survey Units of CFRI covers investigations on 35 coalfields. Under exploration by drilling organizations (CMPDI, GSI, MEC, etc.), over 100 boreholes drilled in 110 blocks have been studied comprising a total corelength of 21,000 m, analysing 45000 samples in all. In addition, work has been continued on physical and chemical survey of coals (5000 samples) from working collieries, including laboratory scale beneficiation tests (900 samples), for aid to industry (900 samples) and railways (2,000 samples). The value of this work has been estimated at over Rs. 24.5 lakh.

At the request of the Geological Survey of India (GSI), 10,600 line km of airborne geophysical surveys, employing magnetometric and scintillometric methods, were carried out over the Cuddapah Basin. This forms a part of a total of 30,000 line km sponsored last year by GSI, of which only 10,000 line km could be covered this year. The techniques and instrumentation for these surveys were developed earlier at NGRI.

NGRI and Groundwater Survey & Development Agency (GSDA), Maharashtra, have jointly selected two sub-basins (Godavari-Purna and Kukadi) in Aurangabad and Ahmednagar districts of Maharashtra for 'Integrated hydrogeological and geophysical studies'. These sub-basins (each covering 1000 sq km area) come under moderate and scarce rainfall regions of the state. Other areas under investigations are Lower Maner Basin (Ramanujapuram area) and Marvanka Basin (Anantpur area), Andhra Pradesh.

NIO contributed significantly towards the development of offshore oil fields and a number of surveys for Oil & Natural Gas Commission and Oil India Ltd., were undertaken at Bombay High, Kori Great and Direction Bank, Muru and Godavari river basins. The surveys were aimed at (a) locating and finding out the nature of pipelines already laid, (b) studying the bottom topography of the drilling sites, (c) conducting oceanographic studies to support drilling activities, and (d) position fixing of drilling rigs.

At the instance of Bharat Gold Mines Ltd. (a Government of India undertaking) assessment of ore reserves in the Nandydroog mine of Kolar gold fields was carried out employing geostatistical methods. Ore reserve calculations were carried out applying computer oriented geostatistical techniques developed at NGRI. The estimated figures for the grade of ore seem to almost match with the 'actuals' from the mine. New sampling designs were proposed, the implementation of which would result in considerable savings (about 59 per cent in the sampling cost) to the gold mining industry at Kolar gold fields.

A research project aimed at performance evaluation of five grades of bitumen produced by the Hindustan Corporation and the Madras Refinery Ltd., taken up by CRRI in collaboration with the Indian Oil Corporation, is

nearing completion. Performance evaluation is being carried out through periodic observation of five test tracks constructed using these grades of bitumen at various places representing different climatic zones throughout the country.

A project on modernization of the Durgapur Steel Plant is being taken up in collaboration with the British Steel Corporation (overseas services). Over 100 tonnes of run-of-mine ore sample from Bolani Ores Ltd. were received and detailed pilot plant washing studies on the sample were successfully completed by NML. The detailed report has since been furnished to the sponsor, viz. Durgapur Steel Plant.

At the request of the Department of Industries, Government of Madhya Pradesh, Bhopal, an exploratory survey of assessment of dust problems in the slate-pencil industry at Mandsaur was conducted by ITRC.

It was found that concentration of both respirable and total dust at breathing zone and in general working environment was much higher than the maximum allowable concentration values. High concentration of dust containing a good percentage of free silica is known to cause lung diseases, particularly silicosis. Recommendations for suitable safety and preventive measures have been made.

Detailed surveys and investigations were undertaken by CRRI and a feasibility report on the manufacture of burnt clay puzzolana and lime-burnt clay puzzolana mixture in the States of Assam, Meghalaya, Tripura, Nagaland and Manipur was given to the North Eastern Council.

For the Department of Highways and Rural Works, Tamil Nadu, CRRI executed the installation of horizontal drains for sub-surface drainage on the Coonoor-Ooty Highway. This work represents a pioneering venture in the field of highway engineering in India. Although the technique of horizontal drains has been followed by the Institute for the last two decades, this is the first time in India that horizontal drains have been installed on a field scale and on a systematic basis with the aid of field instrumentation.

Electron microscopy, spectroscopy (NMR, Mass, IR, UV), gas, liquid/high pressure liquid chromatography, elemental analysis and polarimetry of about 4,000 samples were carried out at the DST-supported Regional Sophisticated Instruments Centre at CDRI for universities, industry and other R&D laboratories.

At the request of the manufacturers, toxicity data on five pesticides, malithrin, chlorpyrifos, malathion, dimethoate and ethion, were generated by CDRI. Under the Insecticides Act, the data are required by the Registration Committee for compulsory registeration.

The Central Facility for Safety Evaluation of Pesticides of ITRC has provided toxicological data on 12 pesticides/formulations, including a test report on fish and birds.

NAL continued to provide R&D support, both of immediate and possible future needs, to various aerospace organizations. A major share of this was through research work with wind tunnel facilities on models of interest to these establishments. Major test programmes executed for external organizations and also to meet the Laboratory's own requirements include data generation on high-lift and manoeuvre devices, roll-damping measurements, investigation on the effect of jet-plume temperature on aft body drag, etc.

The Central Creep Testing Facility at NML has a programme of developing 36 additional test points; 12 points have already been installed. The work done so far has contributed to the acceptance of four grades of steel by M/s Bharat Heavy Electricals Ltd., as substitutes for imported grades.

This year the R.V. Gaveshani of NIO completed 18 cruises in the Indian Seas and besides collecting oceanographic data assisted several organizations, such as ONGC, OIL and the state government of Tamil Nadu, in their work. Scientists from ten organizations availed of the facilities on board the research vessel. The data collected by the ship on pollution, deep sea minerals and living resources were of particular interest.

'Road User Cost Study in India' is a cooperative research project jointly sponsored by the Government of India and the World Bank with CRRI as the implementing agency. The objective of the project is to evolve relationships between different components of road user cost with the vehicle speeds on the one hand and road surface type, geometrics traffic volume and other conditions on the other. Work on various components of this project, namely



Research Vessel Gaveshani of the National Institute of Oceanography, Goa.

speedflow studies, fuel consumption experiments, accident costs and time value studies is in an advanced stage.

NEERI continued to be a WHO Collaborating Centre for Community Water Supply, Sanitation and Air Pollution for the South-East Asia Region. The Institute continues to furnish data on items of mutual interest to WHO International Reference Centres situated around the globe. Under the Indo-US collaborative programme, three projects are in progress: (1) analysis, assessment and treatment of toxic discharges from phosphatic fertiliser and basic organic chemical industries; (2) impact of fugitive and stack emissions from selected industries on neighbourhood air quality; and (3) study of drinking water supplies and sources for virus and bacteria (jointly with NEERI, Nagpur and College of Engineering, Guindy, Madras).

In the wake of the International Drinking Water Supply & Sanitation Decade (1981-1990), two monographs (background documents) entitled 'Guidelines for planning users' surveys in water supply and sanitation' and 'Planning for a National Information Support System in Water Supply and Sanitation' were brought out by NEERI on behalf of WHO IRC for Community Water Supply & Sanitation, The Hague, Netherlands. These were presented at the Regional POETRI Workshop for Latin American & Caribbean Countries held at Lima, Peru during 11-13 November 1980.

A seismic station has been set up at Srisailam dam site by NGRI for continuous recording of microearthquakes in the nearby region. It will be helpful in understanding the seismicity of the region.

Under the collaborative programme of seismic surveillance in the north-eastern region, seismic stations have been installed at (i) Jorhat in Assam, (ii) Kohima and Yaongyimsen in Nagaland and (iii) Khonsa in Arunachal Pradesh; these stations operated satisfactorily during the period.

Survey of the Southern Coast to assess natural resources of seaweeds was continued by CSMCRI in its Marine Algae Research Station at Mandapam. Two survey reports have been brought out covering 50 per cent of the Southern Coast. Work on the cultivation of *Gracilaria edulis* on a sponsored basis was also undertaken. Field trial cultivation of other economic crops was also undertaken.

The field unit of Sea Water Irriculture at Berhampore, Orissa, collects the necessary data on field cultivation of crops with seawater and also experiments to evolve new varieties of crops and selects the localities in Orissa coastal region for sea water irriculture. It is now proposed to introduce plants like Jojoba, Guayule, Juncus, etc.

CLRI and its Extension Centres at Kanpur, Calcutta and Bombay continued to serve as Centres for finished leather certification as per ISI-8170-1977 norms.

DISSEMINATION OF INFORMATION

The Publications & Information Directorate (PID) continued to publish the following journals: *Indian Journal of Pure & Applied Physics* (monthly, Vol. 18-19), *Indian Journal of Chemistry, Sections A and B* (monthly, Vol. 18-19), *Indian Journal of Radio & Space Physics* (bimonthly, Vol. 9-10), *Indian Journal of Experimental Biology* (monthly, Vol. 18-19), *Indian Journal of Biochemistry & Biophysics* (bimonthly, Vol. 17-18), *Indian Journal of Marine Sciences* (quarterly, Vol. 9-10), *Journal of Scientific & Industrial Research* (monthly, Vol. 39-40), *Research & Industry* (quarterly, Vol. 24-25), *Indian Journal of Technology* (monthly, Vol. 18-19) and *Indian Journal of Textile Research* (quarterly, Vol. 5-6).

The other periodicals that were issued during the period are: *CSIR News* (semi-monthly, Vol. 30-31), *Industrial News Digest* (monthly, Vol. 3-4) and *Medicinal & Aromatic Plant Abstracts* (bimonthly, Vol. 2-3).

The revision work of the first volume of *The Wealth of India*: *Raw Materials Series*, was in progress. The sixth volume of *Bharat ki Sampada*: *Prakritic Padarth* was in press.

The Directorate continued to publish the popular science magazines in Hindi (*Vigyan Pragati*, monthly in the 30th year of publication) and Urdu (*Science ki Duniya*, quarterly in the 6th year of publication). The 'Science Reporter Unit' is now functioning as part of the Directorate.

The National Information Centre for Drugs and Pharmaceuticals (NICDAP), a sectoral centre sponsored by DST under the NISSAT scheme at CDRI, continued to publish four specialized monthly bulletins: *Current Highlights* (*R&D*), *Industry Highlights*, *Patent Awareness* and *Current Indian Titles*.

The National Information Centre for Food Science and Technology (FOSTIS) functioning at CFTRI continued the publication of *Food Technology Abstracts*, *Food Digests* and *Food Patents*. Bibliographies on byproducts of food industries (989 references, 1975-79), *guar* gum (178 references, 1950-79), a state-of-art report on *Sal* fat (85 pp.) and a directory of institutional sources in food sciences and technology have also been published during the year.

NEERI has published (in Hindi) a comprehensive 'Waterworks Manual' useful for operators and maintenance personnel in water treatment plants.

The Centre for the Study of Science, Technology & Development (CSSTD), New Delhi, continued to publish "Current Literature on Science of Science (CLOSS)".

CFRI published Volume 3 of 'Indian Coals' pertaining to Giridih and Bokaro coalfields in the nine volume series of monographs on 'Indian Coals'. (Earlier, Volumes 1,2,5 and 6 have been issued).

After completing detailed studies on actual production samples of Bombay High crude oil, IIP prepared a "Bombay High Crude Oil Handbook", which

gives comprehensive basic data on all aspects of this crude. This handbook, prepared for the Oil Industry Development Board, would serve the needs of various refineries using Bombay High crude, for processing and design work.

A comprehensive volume "Science and Society" published by MDU, was released by Professor S. Nurul Hasan, Vice-President, CSIR at a brief ceremony on 28 December 1980.

INTERNATIONAL SYMPOSIA

An International Symposium on Solar Eclipse was held at the Indian National Science Academy (INSA), New Delhi during 27-31 January 1981. The results obtained by the various scientists during the total solar eclipse of 16 February 1980 were discussed extensively to evolve a comprehensive picture of the upper atmosphere during the eclipse. Some other aspects covered at this symposium were: optical astronomy, radio astronomy, animal/bird/insect behaviour, etc. NPL scientists collaborated with INSA in the organization of this symposium.

An International Conference and Exhibition on Ultrasonics (ICEU-80) was organized at NPL during 18-20 July 1980. About 350 delegates, including 17 from overseas, participated. Ninety-three papers were presented. A compilation entitled "Ten Years of Applied Ultrasonics at NPL" was also brought out on this occasion.

An International Symposium on "Chemotherapy and Immunology in the Control of Malaria, Filariasis and Leishmaniasis", co-sponsored by CDRI and ICMR, was held under the chairmanship of Lord Alexander Todd, Nobel Laureate during 18-21 February 1981.

An International Symposium on Lectins as Tools in Biology and Medicine was organized by IIEM during 7-9 January 1981. Thirty scientists from India and abroad participated and presented the latest findings of research on lectins. The deliberations of the symposium are likely to lead to international collaborative endeavours in this area.

The Fifth International Symposium on Airbreathing Engines (ISABE) was conducted by NAL during 16-21 February 1981, cosponsored mainly by the CSIR and Aeronautics Research and Development Board of India. About 80 technical papers covering different aspects of airbreathing propulsion systems were discussed by some 250 experts from various countries. Although the main theme related to airbreathing systems, the technical papers were of considerable significance to the energy sector also.

An International Symposium on Modern Developments in Steel Making was organized by NML during 15-17 February 1981, in collaboration with TISCO, SAIL and the Indian Institute of Metals. The symposium was attended by leading scientists, technologists, executives and consultants in steel-amking from all over the world, including participation from some UN agencies. It could rightly be called the 'Steel Summit'. Keynote lectures and technical papers covering various aspects of steel-making were presented and discussed in eight technical sessions.

A seminar on the Application of Modern Technology to Bibliographic Control and Services was organized by Insdoc on 10 &11 March 1981 in collaboration with the British Council, the National Informatic Centre, the Society for Information Science and the Delhi Library Association. About 70 delegates participated in the seminar, including Mr Peter Lewis, Director-General Bibliographic Services Division, British Library, London.

SAMPLE OF PAPER PRODUCED FROM WATER HYACINTH: RRL (HYDERABAD) AND RRL (JORHAT)

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CENTRE FOR STUDY OF SCIENCE, TECHNOLOGY & DEVELOPMENT

The Centre for the Study of Science, Technology & Development (CSSTD), CSIR accorded high priority to work on the preparation of the progress report on the implementation of the recommendations of CASTASIA-I. The design of the report was prepared around key dimensions of the application of science and technology relevant to the countries of Asia and Oceania, such as social climate for science, education, training and development of S&T manpower, machinery for S&T policies and decision-making, S&T institutional infrastructure and services, level of R&D, research management and care for ideas and individuals, changes in priorities, technology transfer and utilization of indigenous R&D, regional cooperation and study and evaluation of S&T systems. The data sources were identified and relevant information was collected on the key dimensions. Analysis and interpretation of data and the preparation of the draft report are in progress.

The Centre is cooperating with Unesco in the "International Comparative Study on Organization and Performance of Research Units". In this study, five other countries, namely, USSR, Egypt, South Korea, Argentina and Poland, are participating. The main objective of the study is to identify various social, psychological, organizational and managerial factors and assess their influence on the organization and performance of research units. For this study, data were collected from 34 laboratories/institutes/units randomly selected from among 602 research units. Consistency checks were carried out on the data. Work was started on the punching of data.

For the project on "Technology Transfer and its Impact: A Case Study of CSIR Technologies in the Areas of Food Processing, Building Materials and Ceramics" case studies of successful and unsuccessful transfer of technology in these areas were being prepared. A semi-structured questionnaire for collection of data from the laboratories and the licencee firms was prepared on the basis of the conceptual framework of technology transfer that was developed earlier. Discussions were held with the representatives of the firms and NRDC and other laboratories for preparing the following case studies:

a) Baby food
b) Mustard powder
c) Bakers' yeast
d) Grinding wheels for safety razor blades
e) Mica insulating bricks
f) Antimony-free white enamels
g) High draught continuous kiln for burning building bricks
h) Corrugated roofing sheet from coir waste/wood wool
i) Door and window frames from magnesium oxychloride, cement and sawdust

CENTRE FOR STUDY OF SCIENCE, TECHNOLOGY & DEVELOPMENT

The project on "Alternative Strategies for Development" consists of the following phases:

a) Study of the development concepts before independence and their relevance in that context.
b) The philosophy of development that emerges and dominates the development scene in India.

Work has been initiated on the first phase. Relevant literature is being assessed for this purpose.

For the study of "Planning of Research in Chemical Sciences: A Case Study of Pesticides" the data on production, import, foreign technical collaborations and patents filed in India on pesticides during 1969-79 were collected.

A parallel project on the assessment of the fertilizer industry has been taken up involving the same framework as for the pesticides industry.

Work has been started towards the development of a conceptual framework for indigenization of imported technology. Relevant literature is being examined and assessed.

The Centre organized a seminar on "Priorities in Science and Technology" in collaboration with Unesco during 14-23 April 1980. It covered the sectors of agriculture, energy, natural resources, manpower utilization and industry. About 30 participants, including those from Bangladesh, Nepal, Pakistan, Iraq, Iran and Australia, attended this seminar. The proceedings of the seminar are being edited for publication.

The book "Rural Development and Technology: A Status Report-cum-Bibliography" was published by the Centre.

TRAINING COURSES

The seventh course on Administrative Management for junior level executives was organized by the Management Development Unit (MDU) of the Planning Division, CSIR, at RRL, Hyderabad during 16 March - 3 April 1981. Thirty-six participants from CSIR Headquarters and Laboratories located in southern and western regions and six from R&D organizations like the Defence Research and Development Organization, the Indian Councils of Agricultural and Medical Research, the Cement Research Institute, New Delhi, attended the programme.

Fifty-three planning and management scientists and 32 accounts officers participated in a workshop on 'Some Critical Areas of Financial Management in R&D' organized by MDU in two batches (3-5 and 7-9 July 1980) at CSIR Headquarters, New Delhi. The programme was aimed at providing a general awareness of the recent developments in financial management, especially performance budgeting and zero-base budgeting, in the context of the preparation of CSIR's Sixth Five Year Plan. A workshop on R&D Management was organized by MDU at CFRI, Dhanbad during 26 November - 5 December 1980. Forty-five scientists (Projects Leaders and Coordinators), including those of planning divisions, administrative officers and accounts officers, participated in the deliberations of the workshop.

NEERI conducted four major in-service training courses for candidates from public and private sector undertakings, Central and State Water Pollution Control Boards and State Water Supply & Sewerage Boards. These courses were: (i) preventive maintenance of water distribution systems; (ii) solid waste management; (iii) instrumentation in environmental engineering; and (iv) unit processes in waste water treatment.

With a view to encouraging potential entrepreneurs in setting up their own fibre reinforced plastic (FRP) industry, a training course covering theoretical background, practical shop floor practice as well as financial management was organized by CGCRI during 10 January - 14 March 1981, in collaboration with (i) the Government of West Bengal (Ministry of Small Scale Industries); (ii) the Small Industries Service Institute (SISI, Calcutta); (iii) Allahabad Bank (Calcutta), and (iv) FRP Centre, IIT, Madras.

Ninety-six trainees successfully completed the courses offered at the Indo-Swiss Training Centre of CSIO, Chandigarh. They included 73 in instrument technology, 9 (post-diploma) in industrial electronics and 14 (post-diploma) in die and mould making.

A four-week training course in 'Repair, maintenance and handling of analytical instruments used in food laboratories' was organized by CSIO during August 1980. It was jointly sponsored by the Food & Agriculture Organization (FAO), Rome, and the Ministry of Health, Government of India under their Food Contaminants Monitoring Project for India, Nepal and Sri Lanka and was aimed at improving the status of staple food *vis-à-vis*

contaminants. The course had a practical orientation and was attended by 13 participant, 11 from India and 2 from Nepal, representing premier food testing laboratories.

The International School of Milling Technology, the first in Asia, was inaugurated at CFTRI in February 1981. It is an Indo-Swiss venture for training personnel for roller milling industries with emphasis on conditions obtaining in India and other countries of South-East Asia. A 10-month course for about 20 students (one third of whom will be from other countries) will be run by the School.

OTHER ACTIVITIES

NML developed a technique for assessing the extent of accumulation of creep damage through accelerated stress rupture tests. This technique has already been used to predict the state of health of the tubes from the Central Electricity Authority (for the Badarpur Thermal Power Station) and Neyveli Lignite Corporation thermal power plant. Work is now in progress on the tubes supplied by the R&D wing of SAIL.

M/s Jaya Bharatham and Co., Ambur, a new entrant to the field, was provided technical guidance and inplant advice. The firm has now become a leading exporter of finished leathers with an annual tunr-over of Rs. 1.5 crore. Due to the services rendered by CLRI, this level has been reached within a short span of 5 years.

For the Indian Space Research Organization, Bangalore, consultancy services are being provided by SERC, Madras for investigations on the safety of the shell roof of SLV block house against blast and impact due to accidental rocket burst.

At the request of the Madhya Pradesh State Electricity Board, the Centre has furnished proposals for alternative techniques for construction of houses for employees and for office buildings in various locations in the state using prefabricated components to be produced in the state.

The Centre has taken up a sponsored project, at a cost of Rs 1 lakh, at the instance of the Directorate of Town and Country Planning, Government of Tamil Nadu, for developing cyclone-resistant core units in huts along the coastal areas of Tamil Nadu.

For the Ministry of Defence, a consultancy project was undertaken by SERC, Madras for determination of the stress distribution in the male and female jaws of the superstructure of a bridge. This involves photo-elastic investigation on a plastic model.

An internal reference stabilized He-Ne laser was developed by NPL for use as the transfer standard of length. Its frequency stability was measured and found to be 5 parts in 10^9. A reversible fringe counting laser interferometer was developed for measurement with this transfer standard.

New methods for characterization of PAN precursors have been developed at NPL whereby the suitability of a particular PAN grade precursor for conversion to good quality carbon fibres can be established without undergoing the conventional long procedures. These are based essentially on stress-strain analysis and the X-ray diffraction studies on the precursors.

BASIC RESEARCH

Physics (NPL)

Electron paramagnetic spin resonance (EPR) study of nitroxyl and VAAC spin probes in various liquid crystals was made at different temperatures in the liquid nitrogen and room temperature range. The information about the order paramrter, nature and temperatures of phase transitions, etc., provided by these measurements, compares well with similar information obtained from birefringence measurements. A theoretical model has been developed to explain the EPR line shape of these samples.

Detailed and systematic studies on diffuse X-ray scattering (DXS) on nearly perfect crystals have been carried out. The measurements were made using a technique and equipment developed in the Laboratory itself. This system has the highest attainable resolution at present. Remarkable results have been obtained on the contribution of elastic waves to the DXS. This work has shown that the observed DXS is mainly due to point defects and their aggregates. It is not due to phonons, as had been considered till now. This result is of great significance and of fundamental importance. Furthermore, using this technique, quantitative information about point defects and their aggregates has been obtained in a non-destructive fashion. The materials investigated include single crystals of Si, alkali halides and Cu.

The conduction electron spin resonance (CESR) studies carried out for the first time ever on high field superconductors (reported in 1979-80) were continued on numerous important binary and ternary systems. A variety of A-15 superconductors, Chevrel phases and layer compounds were systematically investigated. In all these materials, apart from CESR, spin waves were observed, and the conclusion drawn through previous studies on A-15 superconductors that exchange interactions of antiferromagnetic type in the conduction band are responsible for superconductivity was confirmed. These investigations fitted admirably with the CESR studies carried out on A1, and spin echo measurements of ternary borides carried out by other workers.

Pb-Pb_xO_y-Pb type Josephson tunnel junctions have been developed and these are being tested for their suitability for incorporation in the Josephson Volt standard in place of the Nb-Nb point contact which is being used presently. Development of small area tunnel junctions has also been undertaken, as these are very useful as radiation detectors, SQUIDS, and for many other applications requiring several junctions on a single chip. A very simple 'lift-off' process using only one layer of positive photo-resist has been developed for patterning metal film down to 15 microns width. Important effects related to suppression of energy gap, negative switching at the energy gap, occurrence of phase slip states and microwave power effects have also been observed in lead-based junctions. This work gives significant insight in understanding non-equilibrium superconductivity models.

Detailed investigations have been made on the electrical photoconducting

and electrophotographic properties of lead monoxide powder dispersed in polymeric matrix. It has been shown that considerable improvements in the electro-photographic properties can be achieved by high temperature annealing of the layers. This material seems to be very promising for use in electrophotography and especially for xero-radiography.

Many polymers such as fluorocarbon polymers, i.e. polyvinyledene fluoride and polyvinyl fluoride, copolymers of polyvinyl chloride and polyvinyl acetate, and polymers containing one or more than one active group in the same monomer unit, i.e. polyvinyl butyral, polycarbonates, etc., have been studied for their electrical, dielectric and optical properties, and their use in electrostatic and electro-photographic devices. Mechanisms of polarization and electrical conduction have been established in such polymers in pure as well as doped forms. A new hypothesis has been proposed and trapping of charge carriers has been suggested as the dominant mode of charge storage in many of these polymers.

Electronics (CEERI)

The use of copper as contact and interconnecting material for thin film resistors and hybrid circuits has been studied. The current voltage characteristics of nichrome thin film resistors with copper contacts and contact resistance of Cu-NiCr metallization were measured. The effect of thermal annealing on the contact characteristics has also been studied.

The contact NiCr-Cu I-V characteristics are ohmic. The contact resistance measured by a simple bridge balance technique is 2-3 milli ohm cm^2. The annealing cycle found suitable for stabilizing nichrome resistors with copper contacts is heating at 150°C in air for 48 hours. This cycle is found to be safe for the NiCr-Cu contacts. No significant change in the contact characteristics is observed during the entire annealing cycle and also after annealing. At higher temperature, oxidation and inter-diffusion effects tend to dominate and substantially increase the contact resistance.

The conventional material for contact and interconnection used with NiCr resistors is gold. Copper is a cheaper material, has adequate element conductivity and can be easily soldered.

Research and development work on a novel design of magnetron with electronic frequency switching is in progress. A laboratory prototype with a pulsed-power output of up to 17 kW has been fabricated and tested. In a cold-test model using two PIN-diodes, four frequencies with a gap of about 20 MHz each were obtained by switching them (PIN diodes) in different combinations.

In order to use the frequency allocation to the maximum extent, it has been proposed to use a feed which can provide cross-polarization protection. After comparing the properties of rectangular, circular, square waveguides, it has been found that a corrugated square waveguide can exhibit better cross-

polarization protection. Two channels can be launched through such a feed without any additional band-width.

As regards the properties of the semiconductor materials, it has been postulated that if an antenna structure is printed on the alumina substrate, considerable reduction in axial and transverse direction should be realized, or in other words a compression factor should be obtained. Theoretical work has been carried out in this direction and it has been predicted that a compression factor of the order of 2-56 can actually be obtained. Experimental verification has been carried out and the postulation confirmed. This is useful in miniaturization of the antenna structures. The added advantages of the microstrip antennas will be compactness, reproducibility, reliability, improved performance and low cost.

The Fermi level and effective density of states have been studied for heavily doped silicon causing degeneracy. It reduces the band gap of the silicon, which, in turn, changes the intrinsic carrier concentration. The band gap shrinkage has been explained in terms of the change in lattice parameter due to lattice deformation and dislocation, scattering of carriers by impurities and coulombian interaction of carriers.

An attempt has also been made to explain the current gain of planar transistors from a unified approach. The analysis considers double Gaussian model of the transistor and takes into account degeneracy in the emitter region and mobility variation in the emitter and base regions which so far have only been averaged. The closed form analytical expression for the current gain has been obtained and tested for a few fabricated transistors and for transistors of known impurity profile obtained from the data of earlier workers. It is seen that the gain is very sensitive to the change in emitter profile distribution, and it is maximum for an optimum emitter surface concentration.

Emitter-push in the depression of a base-collector junction beneath a localized emitter diffusion introduces considerable problems in the manufacture of microwave n-p-n transistors using phosphorus diffused emitters. It is also significant in ion-implanted and implanted-diffused structure type of transistors. In this work, the effect of emitter push on the base-transport parameters Ic-Vbe characteristic and transit time have been studied for double-diffused planar transistor structures. It is shown that in the case of base push-out, current is reduced and transit time is increased by a factor depending upon the emitter diffusion time and enhancement factor. The cut-off frequency is reduced significantly.

Poly-silicon is commonly used in MOS ICs as a gate material. A detailed study has been made of the mechanism of impurity diffusion. A method has been established by which one can easily control impurity diffusion in polysilicon of a given thickness and which can successfully be applied in the design and development of MOS ICs and CCDs. The method is simple and

compatible with the fabrication process. A detailed study is underway to establish a model for this.

Instrumentation (CSIO)

Preference for occlusive electrofulguration within the lumen at the divided ends of the vas deferens for male sterilisation over the usually practised vasoligation technique has been expressed by some authorities. The advantages claimed have been minimal damage restricted to the inner layers of the vas in association with the desired permanent impediment to sperm conduction, absence of sperm granuloma formation with minimal fibrous tissue reaction and preservation of adequate vas length for facilitating success of a recanalization operation (if such is desired later), and non-occurrence of spontaneous recanalization, provided this fulguration procedure is combined with deliberate placement of the divided vas ends in different aortal tissue planes at the time of operative closure.

CSIO, in collaboration with the Post-graduate Institute for Medical Education and Research, Chandigrah, undertook studies to determine the efficacy of this technique and has developed a portable battery operated apparatus for this purpose. The studies have been reported in the *Indian Journal of Urology* highlighting successful results of experiments on dogs. In all cases, the fulgurated segment of vas was excised after an interval of 30 days. On histological examination, the divided ends of vas showed maximal degree of occlusion with a bare chink of doubtful lumen remaining patent.

The luminal occlusion was caused by a mass of coagulated protein entangling desquamated epithelial cells and other debris. In no case of the whole series of experiments was there spontaneous restoration of the continuity of the vas between the divided ends.

CSIO is engaged in the development of electron and ion beam based analytical instruments with the key objective to develop electron spectroscopy for chemical analysis (ESCA), Auger electron spectrometer (AES), Ion scattering spectrometer (ISS) and absorption induced changes in the work function measuring unit. For this, efforts are being made to develop a single unit of either single pass or double pass optimized cylindrical mirror energy analyser which can be effectively used at different settings for ESCA, AES and ISS work simultaneously. The demountable type X-ray tube designed at CSIO can accommodate eight targets and hence can produce eight types of X-ray by controlling the position of the anode from outside the vacuum. Associated electronics for the above X-ray tube, which requires 10 kV/600 W highly regulated ripple free dc power supply for ESCA work, has been designed and developed and is under test. System electronics for AES and ISS in one simple arrangement which includes 2 kV/100 μA and high tension ramp to

discriminate electrons in the analyser has also been designed and developed and is undergoing test.

Oceanography (NIO)

The 'MONEX' data compiled by NIO indicate that in spite of the increase in sea surface temperature by about 1°C and decrease in the thickness of the mixed layer by about 10 m., the cyclone heat potential shows an increase from May to June (1979). Transformation of the thermodynamic energy suggests that the energy due to contraction of mixing is important in understanding the water mass structure.

Oceanographic data collected from Andaman Sea revealed that an annual evaporation rate of about 137 cm over the region and the vertical heat transport were confined to top 20 m. of water below which a strong halocline prevented the heat transfer to greater depth. These findings have an important bearing on the moisture transfer and atmospheric circulation in the area.

In the Andaman Sea, Persian Gulf water was identified in the depth range 200-500 m. with a characteristic high salinity and temperature, while in the depth range 500-900 m., the waters of Red Sea origin seem to be present.

Hydrochemical data off the west-coast of India indicated the presence of two oxygen minima associated with two phosphate maxima at depths of about 300 and 100 m.

The effect of heavy metals on two copepod species showed that copper is more toxic than the other metals, viz. iron, manganese, zinc, nickel, cobalt, mercury, lead and cadmium, present in the water and in the particulate matter collected from depths up to 1500 m. from the southern Bay of Bengal and Andaman Sea.

A total magnetic intensity map of the northern part of Konkan coast was prepared on a 100 gamma interval which showed an N-S trend with a number of closures. The conspicuous features of the map are the two major NNW-SSE lineations. The exploration for ilmenite placers of Ratnagiri, Mirya and Kalbadevi showed the ilmenite reserve to be of the order of 2 million tonnes. Shallow seismic records in 13 other bays showed the thickness of the sand to be about 21 m. Thus, the total reserves of ilmenite in these bays appear to be many times greater than that of the Ratnagiri Bay.

A study of the sediments of the regions surrounding Cape Comorin showed that its western side is dominated by terrigenous sediments, while its eastern side is dominated by carbonate sediments.

X-ray diffraction studies on limestone dredged from the shelf (90 m depth) showed that its mineralogy does not indicate its exposure to fresh water resulting either from rainfall or from percolation of ground water. These results confirm that peninsular India had a semi-arid climate in the past.

Regular monitoring along the oil tanker route in the Arabian Sea and the

Southern Bay of Bengal showed that there is an accumulation of nearly 3700 and 100 tonnes of floating tar balls in a year in the surface waters of the Arabian Sea and Bay of Bengal respectively. During the last three years, the concentration of the floating tar in the sea has increased considerably.

NIO has succeeded in identifying about 20 plant and animal species from the sea whose extracts have shown valuable pharmacological properties. The extracts from coral have shown antifertility activity.

A species of sponge was found to be a good source of hormones and corticoids, while a mangrove plant showed analgesic activity. A study of *Hypnea musciformis* revealed that its carrageenan could serve as an effective substitute for imported carrageenans, particularly in respect of anti-inflammatory activity.

The design of a laboratory model of an OTEC plant of 200 W capacity is in progress.

As part of the programme on offshore mineral exploration, NIO has developed the methodology and technique for the exploration of offshore deposits of heavy mineral placers.

Cellular & Molecular Biology (CCMB)

Regulation of essential nutrients transport—The model for regulation of cell division and malignant transformation proposed earlier (Bhargava, *J theor Biol.*, 1977, **68**, 101-137) postulated the existence of a substance *I* that acts as an inhibitor of the triggering of cell division by regulating the transport of essential nutrients. Resting cells are phenotypically I^+ and dividing ones I^- in this model, while transformed cells lose the ability to become I^+.

The substance has now been partially purified and found to be an anionic protein. Assay techniques for the protein have been standardized using transport inhibition in ascitic hepatoma cells and liver parenchymal cells. Isolation of a transport stimulatory factor has also been achieved from the salt precipitable fraction of rat liver intercellular material. This factor is found to stimulate the transport of essential nutrients in parenchymal cells of the rat liver.

Cell membrane and surface

(i) Partial purification of special types of ribonucleases has been achieved from the rat hepatocyte surface. Their activity features are interesting and selective, and it is being investigated whether these enzymes could be considered as restriction ribonucleases.

(ii) Studies on the karyotypes of Zajdela hepatoma and of rat lymphocytes have been made using solid Gieman staining. The hepatoma cells display a great deal of variability in their chromosome count. The plasma membrane proteins of Zajdela cells have been compared with those of normal liver cells.

The former show a few distinct bands that are absent in preparations from normal liver cells. The utility of these proteins as specific markers for, and that of Zajdela cells as models for, malignant transformation, is being investigated.

(iii) Earlier chemical reports on the marked differences in cell surface architecture between transformed, resting normal and dividing normal cells have now been complemented with electron microscopic studies. Electron microscopy of ultra-thin sections of ascitic hepatoma cells has shown that they exist as aggregates with the presence of tight junctions and microcanaliculi and microvilli.

Tumour virology—The structure-function relationship of the enzyme reverse transcriptase (RT) is being studied using RT from avian myeloblastosis virus (AMV). Studies on RT inhibition by the sulphhydryl reagent N-ethyl maleimide (NEM) have shown that NEM causes inactivation by reacting with the SH-containing residues at the template binding site of RT. The initiation of DNA synthesis is affected maximally by the inactivation.

The enzyme is also inhibited powerfully by the protein from seminal plasma called seminal plasmin (SPLN). It has been found that incubation with dNTP causes a conditional inhibition by SPLN.

Experimental evidence suggests the existence of two types of binding sites for dNTP, in the catalytic and the noncatalytic regions of RT. Prior binding of dNTP in the noncatalytic region followed by the binding of SPLN to the enzyme results in changes in the geometry of the catalytic site. Consequently, inhibition of purine incorporation is relieved, while pyrimidine incorporation remains inhibited.

Proteins from bovine seminal plasma

(i) Seminalplasmin (SPLN): It has had shown earlier in CCMB that SPLN inhibits the synthesis of rRNA in whole cells of *E. coli*. Experiments during the current year have shown that SPLN inhibits the synthesis of mRNA *in vitro* and that a significant part of the RNA synthesized in the coupled transcription-translation system is not used as a messenger.

A significant finding during the year is that seminalplasmin inhibits RNA, DNA and protein syntheses in *Candida albicans* (whole cells and protoplasts).

(ii) Antiseminalplasmin: A second protein called anti-seminalplasmin is found in seminal plasma, which reverses the SPLN-mediated growth inhibition of *E. coli* cells. Evidence has been gathered to suggest that this protein might prevent the entry of SPLN into *E. coli* cells.

(iii) A protease and a ribonuclease from seminal plasma: A new protease with unusual specificity has been isolated. It cleaves several proteins to a limit digest, e.g. homoglobin, casein and RNA polymerases from certain sources, but does not cleave some others, e.g., bovine serum albumin, mouse IgG, etc.

Work is in progress to determine whether this protease might have 'restriction' characteristics.

The ribonuclease from seminal plasma, RNAase SPL, which was isolated earlier, has been further characterized. It shows the interesting properties of hydrolysing Mg^{2+} containing native total RNA of *E. coli* to a limit digest containing only large fragments and no acid-soluble material. One cannot compensate for the lower concentration of RNAase-SPL by increasing the reaction time. However, heat-denatured RNA gets degraded to acid-soluble products. Using the ability of RNAase-SPL to recognize certain Mg^{2+} dependent structural features in native naturally occurring RNAs, it has been shown that these features are partially destroyed in e.g. 0.35 *M* KCl. Since the medium for reconstitution of ribosomes uses 0.35 *M* KCl, it seems possible that a partial opening of ribosomal RNAs might be necessary for ribosome assembly.

Liposomes and reverse micelles—Liposomal encapsulation of RNA molecules of various sizes has been achieved. Incubation of the RNA-containing liposomes with RNAase leads to hydrolysis of the RNA to fragments of 4*S* size. The results obtained suggest that large RNA (e.g. rRNA, 23*S*, 16*S* RNA) molecules might span the liposomal bilayer and stick out of the liposome, thereby making part of the molecule susceptible to enzymatic hydrolysis.

Reverse micelles are aggregates of surfactants and lipids in organic solvents, with a central aqueous pool. In effect, they are half-liposomes, but possess greater advantages of optical transparency, controllable size and charge characteristics. Using these, it has been possible to study the conformational features and the biological activities of proteins and enzymes entrapped within the inner aqueous pool, studies that are not generally possible using liposomes.

Protein physical chemistry—The thermodynamics and pathways of folding of an unfolded protein chain into its biologically active and native structure are being studied, with special attention on the enzyme papain. The reversibility of the process and the involvement of intermediate states in the folding are being investigated using spectroscopy.

The interactions of some RNAases with DNA have been studied, and the results obtained indicate that some unwinding of the DNA double helix occurs upon RNAase interaction.

Photoacoustic spectroscopy (PAS)—This new technique of measuring the absorption spectra, thickness and photo-chemical aspects of condensed phases, e.g. intact cells, tissues and organs, is being studied in considerable detail for the first time. Photodamage that occurs to some vitamins in the solid state, the interaction of intact malarial parasites with drugs, and the photo-initiated polymerization of crystals of diacetylenes have been studied using the

PAS method. Aspects of photosynthetic reactions in intact leaves and chloroplasts are being directly studied *in vivo*. It is important to note that no other optical spectrocopic method can be used directly for investigating such *in vivo* processes.

Chemical Biology (IIEM)

The use of carcinoscorpin, a sialic-acid binding lectin from the horseshoe crab, which has been purified to homogeneity, has opened up several channels of research. For example, enterotoxin B produced by cholera bacilli, which seems to attach to the sialic acid portion of intestinal ganglioside, may possibly be thwarted by previously blocking the toxin receptor sites with sialic acid seeking carcinoscorpin; again, immobilized carcinoscorpin may be used for isolating and purifying alpha-fetoprotein and studying its microheterogeneity. In the amoebocytes of the horseshoe crab there is a protein clotting system which forms a gel in the presence of pyrogens. This property of the material has been used in developing a system for detecting pyrogens in biological and pharmaceutical fluids. With adaptation, the method can be used for making pyrogen testing kits. A Bombay-based pharmaceutical company is collaborating with the Institute in regard to this aspect of the programme.

A novel method of using fluorescent polarization which has been developed for investigating binding constants of lectin-carbohydrate interactions has been used in the Institute for conducting equilibrium binding studies on several types of lectins.

With regard to the work on developmental neurobiology of the human foetal brain, further evidence suggests that anaerobic glucose metabolism may be a normal pathway of energy production, while the development of several enzymes, namely succinic dehydrogenase, glutamine synthetase and monoamine oxidase in the central nervous system, has shown interesting multiphasic patterns.

Researches have indicated that prostaglandin E (PGE) is liberated at sites of cholinergic transmission. Although the physiological significance of such release is not clear, it may be postulated that PGE either acts as a neuromodulator at presynaptic level in cholinergic neurotransmission or modifies the postsynaptic responses of cholinergic neuro-transmitters.

Investigation of the molecular biology of *Vibrio cholerae*, the organism responsible for cholera, has revealed that it lacks excision repair mechanism. The finding is being pursued so as to facilitate the development of efficient methods of cholera control.

A new approach to quantitation of hormone receptors and their ligands was developed on the basis of the inhibitor of ligand-conjugated malate dehydrogenase by the specific receptor.

Biosynthesis of thyroxine in extrathyroidal tissue has been established at

molecular level. The enzyme and a special protein responsible for the above synthesis were purified to homogeneity.

The Institute has devised a drug delivery system specifically for delivering drugs to various liver cells. The drug is enclosed in liposomes having sugar markers that recognize such cells; using models of experimentally induced hepatitis it has been possible to demonstrate that the drug can be specifically targeted to diseased cells of the liver. The untoward side effects of drug delivery would thus be minimized.

Botany

(CIMAP)

Genetic improvement of plants basically implies improvement of the seed progenies. In some vegetatively propagated crops like Mentha, lemongrass, etc., failure of seed setting is a bottleneck. Basic studies, though exploratory in nature, were undertaken to ascertain the possibilities of seed setting in these crops. (i) An experiment on seed setting under controlled pollination in *Costus speciosus* revealed the presence of self-incompatibility specificities, since there was no seed setting under selfing. (ii) Examination of more than 1000 pollen grains in *Mentha arvensis* (Japanese mint) indicated 95.75% sterility of pollen grains. Cytological abnormalities, such as numerical and structural changes in the chromosomal complements that are perpetuated through vegetative propagation, appear to be the major causes of very poor pollen fertility in this crop. A thorough cytological investigation is in progress.

Treatment of tubers of *Costus speciosus* with different growth regulators indicated that kinetin and IAA stimulate sprouting significantly and increase tuber yield. Kinetin was also effective in stimulating diosgenin content.

A convenient process for the transformation of citronellal to isopulegol has been developed. Optimum conditions for producing kewda were also established.

1-Propenyl-2,3-4-trimethoxybenzene, a new naturally occurring compound, along with triacontane and β-sitosterol has been isolated from the seeds of *Pleurospermum angelicoids*, a herb found at the altitude of 11,500 ft in the Himalayan region and whose chemistry had not been explored so far.

Hyoscyamus muticus is well known for its tropane alkaloids, but very little work has been done on its non-alkaloidal portion. This work was undertaken on *N. muticus* and nine crystalline compounds were isolated in pure state. During the period under report, structures of four new compounds have been elucidated as 15-hydroxy-helicosanoic acid, 3-hydroxytetratriacontan-3-one, tritriacontan-3-one and pentatriacontan-3-one by IR and MS studies.

From the seeds of *Costus speciosus*, 10 new compounds have been isolated and their structures elucidated employing chemical, enzymatic and physical (NMR, MS) techniques.

Diosgenin has been isolated in varying amounts from the various parts of *Costus speciosus*. It was found that roots are also an additional source of diosgenin (free-0.003%, glycosidic-0.32%). After a detailed investigation, five new compounds were isolated and identified as stigmast-9(11)-en-3B-ol, methyl tritriacontanoate, 24-hydroxyhentriacontan-27-one, 24-hydroxyhentriacontan-26-one and 8-hydroxytriacontan-25-one.

From the plant *Paris polyphylla* Sm. (Liliaceae), polyphyllin E and polyphyllin F were separated earlier. Now their structures have been established on the basis of chemical and enzymatic degradation, exhaustive methylation and NMR and EDMS studies.

Fruits of the plant *Padalium murex* Linn. (*Pedaliaceae*) were analysed chemically and seven crystalline compounds were isolated. When extracted with another solvent, flavonoids were isolated. Identification of all these is in progress.

(RRL, JAMMU)

Inheritance of essential oil constituents like eugenol, thymol, limonens, terpeneol, myrcene, etc. was studied in *Ocimum* spp. The understanding of principles underlying their inheritance is highly useful in planning the breeding programmes for developing strains rich in chemical constituents required by the industry. Study was also initiated to find the incorporation of some of the amino acids in the biosynthesis of monoterpenes in *Ocimum canum* and *Cymbopogon khasianum* using tracer techniques. Valine as amino acid was found to be the best precursor for some of the monoterpenes like linalool in *Ocimum canum* and citral in *Cymbopogon khasianum*. It was further shown from degradation studies of specifically labelled I-^{14}C-DL-valine incorporated into citral in *C. khasianum* that the valine is incorporated through the formation of 3-3-*i*-dimethylacrylic acid by deamination, which, in turn, forms M+PP (dimethyallypyrophosphate) derived from mevalonic acid to form geraniol (pyrophosphate). Studies were also conducted to determine the optimum period of collection of *Adhatoda vasica* leaves to obtain the maximum yield of vasicine, a potent oxytocic and abortifacient.

Drugs & Pharmaceuticals (CDRI)

Multicentric clinical trial (phase III) of the local anaesthetic Centbucridine has been completed so far in about 1500 cases of ophthalmic, dental and general surgery, including patients requiring spinal and epidural anaesthesia. It is comparable to the commonly used anaesthetic lignocaine and bupivacaine in onset and duration of action and efficacy at one-fourth of the dose. No side-effects were noticed.

Efficacy and tolerance studies (phase II trials) of Gugulipid, a hypolipidaemic product from *Commiphora mukul*, and of Centchroman, an

oral contraceptive, have been completed and the data submitted to Drugs Controller (India) for permission to undertake phase III trials. Phase II studies of a neuroleptic (Centbutindole) in schizophrenia and an antidepressant (Centpropazine) are in progress.

A new anthelmintic synthesized in the Institute has shown a wide spectrum of activity against experimental infections with *Hymenolepis nana*, *H. diminuta* and *Raillitina* sp. (tapeworms), *Ancylostoma ceylonicum* (hookworm), *Syphacia obvelata* (threadworm) and naturally occurring *Ascaridia galli* (roundworm) infection in poultry.

Clofazimine, an antileprosy drug, showed activity against both microfilariae and adult worms of *Litomosoides carinii* in cotton rats and microfilaricidal activity against *Dipetalonema vite* in mastomys. Combination of diethylcarbamazine (microfilaricidal) and furazolidone (macrofilaricidal) was found to be effective against both the stages of *L. carinii*. Furazolidone, when administered alone, suppressed metabolic activity and reproductive potential of adult worms.

Nineteen compounds isolated from nine plants have shown interesting biological activity in experimental animals; these include ferujol (early abortifacient) from *Ferula jaeschkeana*, polemoniogenin-3-O-glucuronogalactosyl-arabinoside (spermicidal) from *Polemonium coeruleum* and cynaropicrin (anticancer) from *Amberboa ramosa*. *Coleus forskohlii* has shown promising hypotensive activity.

A phenol-killed bivalent cholera vaccine was found to be as potent as the live vaccine, developed earlier by genetic recombination, which was reported to be better than a commercial vaccine in animal experiments. The killed vaccine was better tolerated by animals.

A *Mycobacterium habana* strain has shown immunogenic property comparable to that of BCG (Phipps) against *M. tuberculosis* infection in mice and guineapigs.

Chronic, non-fatal malaria (*Plasmodium knowlesi*) infection has been developed in *Macaca radiata* (bonnet monkey). Schizont-infected red cells have been cultured *in vitro* to produce merozoites in cell-free state. Purified merozoites were found to be metabolically active and non-infective *in vitro* and *in vivo*. Parasitised-RBC inoculated bonnet monkeys which survived primary infection showed acquired immunity.

Erythrocytic stages of *P. berghei* cultured *in vitro* were found to be infective up to the seventh day of culture to mice and mastomys. The cultured parasites were immunogenic in the surviving animals.

Infection of progesterone-treated mice and hamsters with *P. berghei* produced severe malaria, resulting in death, whereas progesterone or estrogen treatment of rhesus monkeys prior to and following *P. knowlesi* infection significantly increased the peak of parasitaemia and duration of relapse.

Pregnant monkeys infected with *P. cynomolgi cynomolgi* showed significant increase of the peak level, duration and potency of parasitaemia compared to non-pregnant animals.

It has been possible to obtain clones of *Entamoeba histolytica* and *E. invadens*. A serological test for amoebiasis, based on detection of coproantibodies in saline extracts of stools, has been developed.

Sub-dermal implant of a combination of rifampicin (antituberculosis and antileprosy drug) and micro-encapsulated rifampicin with bio-absorbable material, in animals has been shown to provide controlled release of the drug whose concentration in the blood was maintained above the therapeutically effective level for more than 120 days.

Carbamyl analogues of phosphatidylcholines were synthesized as drug carriers and found to be resistant to the action of phospholipase-A_2, but were readily hydrolysed by phospholinase-C. The rate of leakage of solution from these modified liposomes was lower than that of egg lecithin/cholesterol liposomes, and the half-life of the former in blood was slightly higher and the transfer of phospholipid and cholesterol from them was much less.

Studies on adrenoceptive cortical neurones in rats indicate the possible occurrence of specific noradrenergic and dopaminergic receptors and perhaps of a less defined catecholamine receptor on which both noradrenaline and dopamine and their antagonists act. Catecholamine receptors may have a wider distribution and represent a pharmacological rather than a physiological response to the amines.

Maturation of sperms in rats and monkeys is accompanied by 65 per cent reduction in their zinc content. But treatment of the rats with a microdose of estrogen interferes with this reduction during epididymal transport of spermatozoa, thereby suggesting that the antifertility effect of estrogen may be due to inhibition of sperm maturation. Zinc level in the epididymal spermatozoa could be used as a marker of sperm maturation.

Studies on 11 α-hydroxylation of progesterone using *Aspergillus ochraceus* PN66 have shown that zinc ions increase the mycelial growth and conversion and the substrate, when added in lots, is utilized more and better conversion is achieved.

Toxicology (ITRC)

Increased levels of serum copper and ceruloplasmin have been found to be useful diagnostic parameters for early detection of manganese poisoning. Several procedures to test functional changes in the brain due to neurotoxic chemicals have been standardized and applied in animals exposed simultaneously to Pb and Mn. The results obtained have indicated the usefulness of monitoring the functional changes in the detection of neurotoxicity long before the development of permanent structural damage.

Experiments involving multi-metal exposure of animals revealed marked derangement in the metabolism of essential metals like Cu, Zn, Fe and Ca in the brain tissue. Such changes have been found to alter various enzymes concerned with cellular physiology. Metal shifts, therefore, appear to be a significant factor in initiating tissue injury.

On the basis of animal experimentation, dimercaptosuccinic acid (DMS) appears to be extremely useful in controlling lead poisoning. Chelating agents with nitrogen and/or oxygen as electron donating centre appear to be far more effective than those with sulphur as electron donor atom in controlling human manganese poisoning. This suggested poor affinity of manganese compared to other heavy metals, such as cadmium, lead and mercury towards sulphhydryl groups.

Rat liver regenerating after partial hepatectomy has proved to be a useful model in mapping the early changes induced by metals which have liver as their target. Cadmium has been shown to affect the iron metabolism in regenerating liver to a greater extent than tin or nickel. Leucocytes under certain well-defined conditions have helped in understanding some of the cellular changes induced by toxic metals.

The plasticiser DEHP has been shown to inhibit the growth of the testis and affect spermatogenesis in rats. The fertility of male rats after 30 days of DEHP exposure was significantly affected. Studies were also conducted to evaluate the toxicogenic potential of di-*n*-butyltin dilaurate (DBTL), a widely used stabilizer on vital organs of rats. Acrylamide, a widely used monomer in the production of polyacrylamide, was evaluated as a substrate for brain glutathione-*s*-transferases. Studies provided evidence that brain is equipped with glutathione-*s*-transferases catalyzed conjugative biotransformation mechanism for disposal of neurotoxin, such as acrylamide. Studies regarding the vulnerability of developing rats to acrylamide toxicity revealed that acrylamide is more toxic to growing rats as compared to adults.

Mathematical formulae for determining predictive indices for biomagnification, ecotoxicology, relative biotransformation and comparative toxicity were developed. For experimental studies on the effect of environmental pollutants on ecosystems, a model system for terrestrial flora comprising all forms of nature—life interaction, namely, autotrophy, symbiosis, parasitism, pathogen and competitor in the same closed glass chamber with provision for feeding and monitoring pollutants in soil, water, and air was developed. The concept of xenobiotic receptor was established from the study of protein-silica interaction and the clearance of iron from haematite dust in lung through binding with proteins. Synthetic detergents, which form major ecological pollutants, were found to merit attention regarding their dermal toxicity, as evident from animal studies.

BASIC RESEARCH

Materials (RRL Trivandrum)

Deformation and fracture studies of coir fibres

Studies on plastic deformation, stress relaxation and elastic properties of coir fibre were carried out to assess its deformation characteristics. Fracture energy (10^5-10^6 j/m^2) obtained for coir is found to be comparable with the published data for other plant fibres. The fracture mode in coir fibres of different diameters studied through SEM indicated that the failure of the fibre is due to the fracture of the cells themselves accompanied by the uncoiling of the microfibrils.

Strength-size correlation in natural fibres

Studies were made on strength-length and strength-diameter relationships of coir and banana fibres. The results obtained indicate that in the case of coir, Weibull distribution of strength is followed. Similar work is in progress for banana fibre.

Ultrasonic studies on composite materials

Ultrasonic velocity and attenuation measurements made on a number of particulate composites with Al-matrix have thrown light on particle-matrix bonding characteristics and their influence on the mechanical properties of the composites.

Internal chilling/microchilling studies of aluminium base alloys

Experiments on internal chilling of aluminium base alloy castings have indicated that internal chill/microchill reduces piping, enhances mechanical properties and arrests graphite flotation in sand cast graphitic aluminium castings.

GENERAL

The Society of CSIR was reconstituted in June 1980 for a period of two years w.e.f. 6 June 1980. The Society met on 15 December 1980 under the Chairmanship of the Prime Minister. At this meeting, the Society approved of a recommendation of the Governing Body to adopt the Cabinet decision on the re-transfer to CSIR of CBRI, Roorkee, CFRI, Dhanbad, CRRI, New Delhi, and HP, Dehra Dun. The re-transfer became effective from 1 February 1981.

The Governing Body meetings were held on 13 June, 30 September, 22 October, 28 November, 4 December and 25 December 1980 and 21 February 1981.

The Planning Division continued its activities relating to the formulation of the annual plans of the national laboratories and their coordination both within and outside the CSIR system. By the year end, the Division finalised the draft annual plan 1981-82 after identifying major programmes of the laboratories. New initiatives have been taken for the first time in the preparation of R&D plans of laboratories and their integration as a CSIR Plan for presentation to the Planning Commission. The Division identified the thrust areas on which the laboratories would be undertaking major R&D programmes during the Sixth Plan period. The total resources required for these programmes during the Plan period were shown on the basis of areas and not laboratory-wise which had hitherto been the case. As a new concept this is a major departure and the Planning Commission welcomed the new initiatives taken by the Planning Division. The resource allocation exercise was undertaken on the basis of systematic analysis of the data provided by the laboratories and the monitoring data generated by the Planning Division on the basis of such analysis.

The Governing Body of C.S.I.R. at its meeting held on 30 September 1980 approved of the proposal to upgrade the Management Development Unit as the Centre for Management Development in R&D as part of the Planning Division of CSIR Headquarters.

The Department of Industrial Development, Ministry of Industry, Government of India has sponsored a project to be undertaken by MDU for a period of 5 years for working out details for the establishment of an experimental field station in the District of Bankura, West Bengal, for technology transfer to the tribal and backward communities of the district. MDU is proposing to conduct a techno-economic survey and organize a seminar of scientists of various R&D laboratories and rural artisans of the district.

The Technology Utilization Division continued to maintain close contact with the Central Ministries of Agriculture, Industry, Health & Family Welfare, Department of Science & Technology, Directorate General Technical Development, etc. During the year, nearly 330 foreign collaboration applications were received from the Government for scrutiny and comments.

The Division participated in 58 meetings of the Technical Evaluation Committee (TEC) and its 12 Sub-Committees held during the year. The Division is also represented on the Screening Committee for recognition of R&D units, the Committee for delicensing of industries based on indigenous technology and the Committee for consideration of proposals under Section 35 (2B) of the IT Act of the Department of Science and Technology.

The Technical Information Centre for Chemical Industries, Bombay, set up with 50 per cent financial participation of the Indian Chemical Manufacturers' Association (ICMA) continued its service of dissemination of information to its members. As per the decision of its Advisory Committee, it has now started charging a nominal fee for specialized assistance. The service has become so popular that the Association has proposed broadening its scope further.

Under an agreement signed with the National Informatic Centre, an NIC computer terminal was installed at Insdoc which will make available the data base available with NIC as well as provide HP1000 computer facilities for various Insdoc/CSIR activities.

The Division of Scientific and Technical Personnel (DSTP) brought out 8 issues of 'Technical Manpower' during the year. Some of the important studies published are 'Utilization of expertise of expatriate Indians abroad', 'Social scientists in the Scientists' Pool' and 'Out-turn of engineering personnel by the professional societies in India'. In addition, 4 issues of 'Pool Supplement' containing particulars of persons selected to the Scientists' Pool and 4 issues of 'Indians Abroad' directories containing particulars of scientists, technologists, engineers and medical personnel with overseas qualifications/training, were also brought out.

Four hundred and seventy three persons were selected to the Scientists' Pool during the year, bringing the total, as on 31 March 1981, to 14,107. Since the inception of the scheme in 1958, 6420 persons had joined the Scientists' Pool. The number of Pool Officers, as on 31 March 1981, was 317. A Specialists Register is being maintained by the Division, which till the end of the year, had enrolled 33000 specialists. This Register is being referred to locate persons of various specializations.

One hundred and ninety four new research schemes were approved for financial assistance during the year. Out of the 450 ongoing research schemes from earlier year, 122 schemes were completed during 1980-81; 437 research schemes have been renewed for 1981-82. A total of 430 Junior Research Fellowships, 296 Senior Research Fellowships and 40 Research Associateships have been sanctioned for the schemes to continue in 1981-82. These were processed and administered by the Extra-Mural Research (EMR) Division of CSIR Headquarters.

About 1600 new Research Fellowships/Associateships were offered and

accepted by the incumbents. The number of direct research fellows as on 1 March 1981 receiving assistance from CSIR is about 4100 (3800 in academic and research institutions other than CSIR and about 300 in CSIR Labs.). In addition, there are 70 Research Associates receiving the grants. Thus the total number of fellowships (both direct and related to grants-in-aid schemes) is at present 4,800 and of Associateships (including those in schemes processed by EMR) 110.

Grants were given to 15 language periodicals; of these, 4 are in Hindi, 3 in Malayalam, 2 in Tamil and one each in Assamese, Bengali, Gujarati, Kannada, Marathi and Oriya.

Grants were also given to learned societies for organization of symposia/seminars, numbering 40 in the year 1980.

The S.S. Bhatnagar prizes for the years 1978 and 1979 were presented to 18 recipients by Shrimati Indira Gandhi, Prime Minister of India and President, CSIR at a function held on 25 July 1980. The awards for the year 1980 were finalized and announced.

The three-year tenure of the 12 Research Committees ended on 31 March 1981. These Committees have now been reconstituted for a further period of three years.

Polytechnology Transfer Centres

The CSIR Polytechnology Transfer Centres (PTC) functioning in 10 state capitals, viz. Ahmedabad, Bangalore, Bhopal, Bombay, Calcutta, Hyderabad, Lucknow, Patna, Shillong and Trivandrum continued to provide diagnostic service to industries by identifying their technological, engineering and related problems and arranging for their solution through national laboratories and other R&D institutions in the country.

During the year the scientists visited/revisited 1054 industrial units and identified 817 problems, of which 368 were solved. They attended to 634 technical enquiries.

The following are some significant achievements:

1. The design of a 'Cupola' developed by NML was provided to a party at Rajkot by PTC, Ahmedabad. The furnace thus set up resulted in a saving of more than 50 per cent in fuel consumption.
2. PTC, Hyderabad organized a problem-oriented consultancy workshop on ferrous foundries at Vijayawada in December 1980 in association with the A.P. State Govt. and the Industrial Development Bank of India through the Industrial and Technical Consultancy Organisation Ltd., Hyderabad. Seventy-two industrial units, along with experts in the field, participated. The workshop stimulated important decisions relevant to the growth of the industry.

3. PTC, Patna promoted studies at NML to reduce the quantum of rejections in the manufacture of aluminium utensils. In-plant trials undertaken proved that it was possible to bring down the rejection rate appreciably. These studies will be of much benefit to the aluminium utensil manufacturers.
4. PTC, Trivandrum took up the problem of gainful utilization of coconut waste, with MERADO, Madras, IIT, Madras, CFRI, Dhanbad, CFTRI, Mysore, FEDO and Karnataka Carbons Pvt. Ltd. for making active carbon and carbonised briquettes. MERADO, Madras has taken up the design of a sophisticated drier for coconut under the sponsorship of a party.
5. At the instance of PTC, Patna, RRL Jammu has taken up a sponsored work on process development for the recovery of pyridine bases by a combination of fractional distillation and solvent extraction. This work is aimed at utilization of the byproducts available at the Bokaro Steel Ltd., where pyridine base mixture is available in plenty.
6. As a result of the initiative taken by PTC, Hyderabad, the Madras Unit of NML has taken up a project for the recovery of molybdenum from molybdenum slurry for the Hindustan Machine Tools Ltd., Hyderabad.

HONOURS & AWARDS

Dr. J.C. Negi of NGRI, Hyderabad has been awarded (along with Dr. B.K. Sahu, IIT, Bombay) the SS Bhatnagar Prize for S&T 1980 for outstanding contributions to earth sciences.

Dr. Nitya Nand, Director, CDRI was awarded the Acharya J.C. Ghosh Medal of the Indian Chemical Society for the year 1980. He has been nominated Chairman of the Steering Committee of the WHO Working Group on Chemotherapy of Malaria, and a member of the Scientific Advisory Committee to the Cabinet from 1.4.1981 to 31.3.1983.

Dr. C.R. Krishna Murti, Director, ITRC, Lucknow was awarded the Sunder Lal Hora Medal for the year 1981 by the Indian National Science Academy, New Delhi.

Dr. C.K. Atal, Director, RRL, Jammu, has been awarded the Prof. G.P. Srivastava Memorial Award for 1980 by the Association of Pharmaceutical Teachers of India.

Dr. R.B. Mitra, of NCL, Pune, has been awarded the Dr. K.G. Naik Gold Medal by the M.S. University, Baroda, for the year 1979.

Dr. G. Lakshminarayana, of RRL, Hyderabad, was awarded the Dr. S.H. Zaheer Memorial Award for the year 1980.

Shri B.K. Mazumdar of CFRI, Jealgora, has been awarded the first Senior Coal Scientist Award instituted by the Ministry of Energy & Coal, Govt. of India.

Prof. V.A. Altekar, Director & S/S M.J. Shahani, A.K. Saha, of NML, Jamshedpur, have been awarded the Sir Ganga Ram Memorial Gold Medal for 1979-80 (awarded in Feb. 1981) by the Institution of Engineers (India).

Prof. C.G. Swaminathan, Director and Dr. N. Bansi Lal of CRRI, New Delhi were jointly awarded the Indian Roads Congress Medal for their paper entitled "Appropriate technologies for rural road development".

Dr. Bhagwant Singh of CMRS, Dhanbad, has been awarded the Dewan Bahadur D.P. Thacker Coal Mining Gold Medal for 1979-80.

Dr. E. Shyam Prasad Reddy of CCMB, Hyderabad was awarded the Young Scientist Award of the Indian National Science Academy for 1980.

Dr. D.C. Amla, Research Associate, NBRI, Lucknow has been awarded the Young Scientist Award of the Indian National Science Academy, New Delhi for 1980.

Dr. K.S. Rajagopalan of CECRI, Karaikudi, has been awarded the Mascot National Award for the year 1980.

Dr. P.V. Sankaranarayan of NGRI, Hyderabad was awarded the Decennial award of the Indian Geophysical Union for 1980.

Dr. S.K. Verma of NGRI, Hyderabad has been awarded the Krishnan Medal of the Indian Geophysical Union, for 1980.

Shri K. Bhatia and his colleagues of RRL, Jammu were given the Yezdi award-1980 for the best paper published in *the Indian Food Packer*.

HONOURS & AWARDS

Dr. R. Kumar of NML, Jamshedpur has been awarded the Dr. Rajendra Prasad Memorial Gold Medal for 1978-79 (awarded in 1980) by the Institution of Engineers (India).

Shri G.P. Mathur of NML, Jamshedpur, has been awarded the 'Indranil Gold Medal for Metallurgy' for the year 1978-79 (awarded in 1980) by the Mining Geological and Metallurgical Institute of India.

Shri P.S. Appu Kuttan, Dr. Subal Bishayee, Dr. Avadhesha Surolia and Dr. D. Thambi Dorai of IIEM, Calcutta were awarded the 1979 Vividhlaxi Audhyogic Samshodhan Vikas Kendra (VASVIK) Research Award for biological sciences.

Dr. I.B. Gulati, Director, IIP, Dehra Dun, has been elected a Fellow of the Indian Standards Institution.

Prof. C.G. Swaminathan, Director, CRRI, New Delhi has been elected President of the Indian Roads Congress for the current year.

Dr. B.N. Dhawan of CDRI, Lucknow has been elected a Fellow of the National Academy of Medical Sciences.

Dr. A.B. Sen of CDRI, Lucknow has been elected a Fellow of the Indian National Science Academy.

Dr. P.M. Bhargava, Head, CCMB, Hyderabad has been elected President of the Society of Biological Chemists, India.

Dr. S. Kumar of CGCRI, Calcutta was elected President of the Indian Ceramic Society for 1980-81.

Prof. D. Balasubramanian of CCMB, Hyderabad has been elected Fellow of the Indian Academy of Sciences.

Dr. V.V.R. Varadachari of NIO, Dona Paula, Goa was elected a Fellow of the Indian National Science Academy.

RRL, Jammu was awarded the Federation of Indian Chambers of Commerce and Industry Award for 1980 for outstanding work in rural development.

CFTRI has been honoured with the Indian Merchants Chamber Award for 1979 in recognition of its outstanding contribution to the development of post-harvest technologies for efficient processing and conservation of food.

STATISTICAL TABLES

FINANCIAL DATA

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH: FINANCIAL DATA
(Rs. in lakhs)

Particulars	1978-79			Actual Expenditure for 1979-80			1980-81		
	Non-Plan (1)	Plan (2)	Total (3)	Non-Plan (4)	Plan (5)	Total (6)	Non-Plan (7)	Plan (8)	Total (9)
1. Central Administration									
(i) Pay and Allowances, Contingencies, Maintenance	388.060	27.810	415.870	414.110	32.060	446.170	450.720	27.571	478.291
(ii) Headquarters Technical activities	121.579	1.652	123.231	119.363	4.700	124.063	146.769	5.968	152.737
(iii) Misc., Pensions, Advances etc.	10.099	8.079	18.178	13.292	13.428	26.720	18.328	1.244	19.572
2. Laboratories	256.382	18.079	274.461	281.455	13.932	295.387	285.623	20.359	305.982
3. Scientists' Pool	2389.270	1480.640	3869.910	2521.220	1735.360	4256.580	2743.450	2088.976	4832.426
4. Research Schemes, Scholarships and Fellowships	59.580	—	59.580	52.970	—	52.970	46.320	—	46.320
5. Industrial Research Associations	167.840	122.960	290.800	—	312.650	312.650	—	339.974	339.974
6. Pilot Plants	43.500	11.970	55.470	53.240	14.630	67.870	52.864	20.790	73.654
7. Residential Buildings	—	136.600	136.600	124.510	—	124.510	148.745	—	148.745
	40.450	133.700	174.150	39.780	97.610	137.390	44.035	149.017	193.052
Total	3088.700	1913.680	5002.380	3205.830	2192.310	5398.140	3436.134	2626.328	6112.462

NON-PLAN—SUB-HEADWISE BREAKUP OF ACTUALS FOR THE YEAR 1980-81

(Rs. in lakhs)

Laboratory/ Institute	RECURRING							CAPITAL					
	P1-Pay of Officers	P2-Pay of Estt	P3-Allo-wances	P4-Contin-gencies	P6-Main-tenance	P7-Chem. App & Equipt	Total Rec	P5(3) App & Equipt	P5(4) (i) Furn	P5(4) (ii) Lib Books	P5(4) (iii) Vehicles	Total Capital	Grand Total Cols 8 + 13
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Physical Sciences Group													
NPL	28.250	33.890	58.000	18.500	3.220	17.000	158.860	15.047	—	7.490	—	22.537	181.397
TEC	1.234	1.681	2.189	1.019	—	0.608	6.731	—	—	—	—	—	6.731
CEERI	11.320	19.880	22.650	8.873	1.801	10.420	74.944	4.493	—	3.491	—	7.984	82.928
CSIO	11.220	24.000	33.200	14.000	1.690	22.500	106.610	—	—	2.000	0.211	2.211	108.821
NGRI	13.200	19.670	33.000	13.280	1.304	17.350	97.804	—	—	2.496	0.660	3.156	100.960
NIO	7.070	10.580	17.021	7.060	1.005	6.409	49.145	—	—	3.500	0.010	3.510	52.655
Boat Opn.	—	—	—	—	—	3.862	3.862	—	—	—	—	—	3.862
Total I.	72.294	109.701	166.060	62.732	9.020	78.149	497.956	19.540	—	18.977	0.881	39.398	537.354
II. Chemical Sciences Group													
NCL	33.169	32.811	52.360	18.000	1.749	17.360	155.449	28.000	—	9.600	—	37.600	193.049
CECRI	14.400	23.450	28.050	10.958	1.000	17.360	95.218	2.255	—	2.250	0.293	4.798	100.016
CSMCRI	11.620	11.730	17.360	3.830	0.550	6.620	51.710	—	—	2.000	—	3.000	53.710
RRL, Hyd.	25.220	32.670	55.228	19.000	1.604	18.167	151.889	13.978	—	3.934	1.463	19.384	171.273
RRL, Jorhat	9.590	13.880	19.000	5.500	1.051	6.340	55.361	—	—	3.497	0.450	3.947	59.308
Total II.	93.999	114.541	171.998	57.288	5.954	65.847	509.627	44.242	—	21.281	2.206	67.729	577.356
III. Engineering Sciences Group													
NML	26.160	33.030	49.138	19.346	3.754	12.050	143.478	0.699	—	3.798	(−)0.127	4.370	147.848
CGCRI	13.490	21.320	31.690	7.400	0.941	6.494	81.335	2.539	0.073	2.151	(−)0.001	4.762	86.097
CMRS	19.670	14.830	26.990	7.095	1.492	2.605	72.682	—	—	1.882	—	1.882	74.564
CMERI	27.810	36.050	49.500	13.503	2.716	7.892	137.471	—	—	3.450	0.388	3.838	141.309
NEERI	11.200	18.140	28.627	7.150	1.247	5.770	72.134	—	—	1.673	—	1.673	73.807
NAL	30.560	40.210	67.410	16.000	2.248	37.620	194.048	14.963	—	10.204	—	25.167	219.215
RRL, Bhub	6.521	7.479	10.746	6.282	1.000	6.080	38.108	—	—	2.797	—	2.797	40.905
SERC(R)	4.681	4.277	7.680	2.595	0.500	3.537	23.270	—	—	0.749	—	0.749	24.019
SERC(M)	4.130	3.110	6.376	2.900	—	5.500	22.016	—	—	1.100	—	1.100	23.116
CSIR Madras Complex	0.690	3.190	4.294	3.602	0.650	—	12.426	—	—	—	0.556	0.556	12.982
Total III	144.912	181.636	282.451	85.873	14.548	87.548	796.968	18.201	0.073	27.804	0.816	46.894	843.862
IV. Biological Sciences Group													
CFTRI	25.850	30.164	46.550	11.750	2.503	18.096	134.913	4.003	2.000	5.003	—	11.006	145.919
CDRI	22.900	25.750	41.880	16.000	3.000	20.950	130.480	7.500	0.500	5.250	—	13.250	143.730
CLRI	14.110	16.180	29.995	8.716	0.846	11.300	81.147	—	—	2.000	0.958	2.958	84.105
NBRI	8.380	18.872	25.740	6.000	0.910	10.855	70.757	—	—	1.865	0.915	2.780	73.537
IIEM	5.870	9.680	16.410	3.360	0.458	4.120	39.898	4.998	—	5.001	0.592	10.591	50.489
RRL, Jammu	11.920	15.611	25.890	7.750	2.050	18.900	82.121	3.000	—	3.750	—	6.750	88.871
CIMAP	3.270	5.620	9.600	7.880	0.375	5.240	31.985	0.750	0.200	2.254	0.572	3.776	35.761
ITRC	5.850	4.780	10.500	5.100	0.550	6.070	32.850	—	—	2.082	—	2.082	34.932
CCMB (RRL, Hyd.)	1.060	0.810	2.029	—	—	2.200	6.099	—	—	1.000	—	1.000	7.099
Total IV	99.210	127.467	208.594	66.556	10.692	97.731	610.250	20.251	2.700	28.205	3.037	54.193	664.443
V. Information Science Group													
INSDOC	9.150	11.450	18.120	9.000	1.271	6.400	55.391	—	—	5.500	—	5.500	60.891
PID	8.220	8.250	14.140	9.244	1.380	17.150	58.384	—	—	1.160	—	1.160	59.544
Total V	17.370	19.700	32.260	18.244	2.651	23.550	113.775	—	—	6.660	—	6.660	120.435
Grand Total I-V	427.785	553.045	861.363	290.693	42.865	352.825	2528.576	102.234	2.773	102.927	6.940	214.874	2743.450

PLAN—SUB-HEADWISE BREAKUP OF ACTUAL EXPENDITURE FOR 1980-81

(Rs. in lakh)

Laboratory/ Institute	RECURRING							CAPITAL							
	P1-Pay of Officers	P2-Pay of Estt	P3-Allow-ances	P4-Contin-gencies	P6-Main-tenance	P7-Chemi-cals, App & Equipt	Total Rec	P5(3) App & Equipt	P5(4) (i) Furniture	P5(4) (ii) Lib Books	P5(4) (iii) Vehicles	P5(4) (iv) W/shop stores	P5(4) (v) Models & Exhi	P5(4) (vi) Misc	Total Capital	Grand Total Rec + Capital
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
I. Physical Sciences Group																
NPL	5.646	2.109	4.049	1.169	—	8.124	21.097	54.825	0.659	—	0.013	—	—	—	64.782	85.879
CEERI	8.941	1.224	6.733	—	—	8.508	25.406	51.000	0.500	—	—	—	0.100	—	68.532	93.938
CSIO	9.795	2.886	4.480	1.498	—	8.572	27.231	31.835	0.992	—	0.700	—	—	—	39.843	67.074
NGRI	4.540	5.076	6.112	3.664	—	16.824	36.216	24.990	1.249	—	0.007	—	0.049	—	42.234	78.450
NIO	5.443	5.080	5.847	4.904	—	6.201	27.475	33.851	0.975	1.500	—	—	—	—	52.909	80.384
Boat Operation	—	—	—	—	—	86.560	86.560	—	—	—	—	—	—	—	—	86.560
Total I	34.365	16.375	27.221	11.235	—	134.789	223.985	196.501	4.375	1.500	0.720	—	0.149	—	268.300	492.285
II. Chemical Sciences Group																
NCL	6.893	2.548	5.903	3.657	—	11.843	30.844	50.004	1.497	1.499	—	—	—	2.500	77.843	108.687
CECRI	3.829	0.239	3.573	—	—	3.464	11.105	35.682	1.302	—	—	—	0.175	—	56.843	67.948
CSMCRI	2.644	1.513	2.457	2.393	—	4.498	13.505	25.406	0.479	—	0.925	—	—	—	34.331	47.836
RRL, Hyderabad	7.285	3.836	5.870	3.495	—	12.700	33.186	36.662	2.012	—	1.508	—	—	—	68.119	101.305
RRL, Jorhat	4.632	2.751	5.839	2.003	—	8.010	23.235	19.790	0.999	—	0.898	—	—	—	38.146	61.381
Total II	25.283	10.887	23.642	11.548	—	40.515	111.875	167.544	6.289	1.499	3.331	—	0.175	2.500	275.282	387.157
III. Engineering Sciences Group																
NML	7.210	2.170	6.190	—	—	—	15.570	19.419	0.448	—	—	—	—	—	23.141	38.711
CGCRI	1.497	0.643	1.977	1.297	—	3.316	8.730	35.483	0.196	—	—	—	—	—	37.378	46.108
Naroda Centre	0.197	0.813	0.952	0.760	0.268	0.499	3.489	0.724	0.048	0.056	—	—	—	—	0.828	4.317
CMRS	1.903	0.005	3.191	—	—	—	5.099	22.160	0.600	—	—	—	—	—	25.596	30.695
CMERI	0.132	0.077	4.716	—	—	—	4.925	5.241	0.869	—	—	0.047	—	—	15.251	20.176
NEERI	3.113	0.461	—	2.994	—	2.743	9.311	10.894	0.572	—	—	—	0.038	—	18.425	27.736
NAL	7.705	4.460	4.926	15.770	—	10.091	42.952	89.515	1.727	0.504	—	—	—	—	109.810	152.762
NTAFC	—	—	—	—	—	1.777	1.777	—	—	—	—	—	—	—	—	1.777
RRL, Bhub.	4.900	—	2.586	—	—	3.003	10.489	27.590	0.399	—	—	—	0.040	—	40.449	50.938
SERC, Roorkee	—	—	—	—	—	1.097	1.097	6.892	0.197	—	—	—	—	—	7.089	8.186
SERC, Madras	2.737	0.746	3.235	—	—	2.040	8.758	9.029	0.500	—	—	—	0.021	10.000	19.550	28.308
Madras Complex	0.240	0.761	0.985	—	—	—	1.986	0.005	0.400	—	—	—	—	—	20.220	22.206
RRL, Trivandrum	4.570	4.756	8.521	3.945	0.184	3.750	25.726	15.745	0.979	3.132	0.008	—	0.086	—	29.484	55.210
CSIR Cochin Complex	1.040	0.919	1.461	0.456	0.047	0.097	4.020	1.012	0.119	0.329	—	—	—	—	1.804	5.824
Total III	35.244	15.811	38.740	25.222	0.499	28.413	143.929	243.709	7.054	4.021	0.008	0.047	0.185	10.000	349.025	492.954
IV. Biological Sciences Group																
CFTRI	8.764	—	1.708	2.999	—	8.153	21.624	32.026	0.998	—	—	—	—	—	50.461	72.085
CDRI	3.628	1.582	2.380	5.850	0.270	19.830	33.540	23.499	0.999	—	—	—	—	—	55.844	89.384
CLRI	4.507	3.527	2.861	2.503	—	2.355	15.753	32.633	1.741	—	—	—	0.074	—	50.211	65.964
NBRI	4.423	—	2.550	2.200	—	7.325	16.498	10.000	0.593	1.000	1.429	—	—	—	32.992	49.490
IIEM	1.789	1.067	1.580	2.996	—	6.650	14.082	24.440	0.298	—	—	—	—	—	34.112	48.194
CSIR Biochemical Centre	0.990	2.294	3.695	4.215	0.192	5.230	16.616	5.761	0.201	0.068	—	0.066	—	—	6.956	23.572
RRL, Jammu	3.128	0.650	1.056	4.450	—	9.327	18.611	37.950	1.500	—	—	—	—	—	52.930	71.541
CIMAP	2.300	2.417	2.617	1.437	—	6.124	14.895	25.037	3.923	—	0.750	—	—	—	64.430	79.325
ITRC	1.883	2.717	5.478	3.398	—	8.500	21.976	21.965	0.998	—	—	—	—	—	32.196	54.172
CCMB	1.315	1.169	4.235	3.249	—	6.300	16.268	22.965	1.500	2.499	0.576	—	—	—	65.959	82.227
Total IV	32.727	15.423	28.160	33.297	0.462	79.794	189.863	236.276	12.751	3.567	2.755	0.066	0.074	—	446.091	635.954
V. Information Science Group																
INSDOC	2.982	0.025	2.631	0.929	—	7.070	13.637	2.687	0.379	6.006	—	—	—	—	29.965	43.602
PID	3.018	0.494	2.536	—	—	5.582	11.630	3.500	0.481	0.800	—	—	—	0.475	5.604	17.234
Total V	6.000	0.519	5.167	0.929	—	12.652	25.267	6.187	0.860	6.806	—	—	—	0.475	35.569	60.836
G. Total I-V	133.619	59.015	122.930	82.231	0.961	296.163	694.919	850.217	31.329	17.393	6.814	0.113	0.583	12.975	1374.267	2069.186

APPENDIX I

PROCESSES THAT HAVE GONE INTO PRODUCTION
(FOR THE FIRST TIME 1980-81)

Sl. No.	Process	Party	Nature of Licence
	Products of Food Industry, Including Beverages		
CFTRI			
1	Tamarind powder	K. Veerabadra Mudaliar & Co., Mysore	Non-exclusive
2	Orange and lime/lemon flavour blends	Sweeta Bottling, Puttur	Non-exclusive
3	Egg albumen flakes	Al Flakes Industries, Mysore	Non-exclusive
4	Papain	Superlab., Mysore	Technical aid
	Chemicals		
CFRI			
5	Beta-naphthol	Eastern Naphtha Chemical Ltd., Dhanbad	Non-exclusive
CLRI			
6	Urethane varnish based on castor oil as a top coat	Sarjit Dhande, Ludhiana	Non-exclusive
CSMCRI			
7	Calcium silicate, moulded	Amarnath Bhaskar & Sons, New Delhi	Non-exclusive
8	Bromine from sea bittern	Hindustan Salts Ltd., Khargoda	Non-exclusive
NCL			
9	Endosulfan	(1) Bharat Pulverising Pvt. Ltd., Bombay (2) Hindustan Insecticides Ltd., New Delhi	Non-exclusive
RRL (H)			
10	Glyoxal	(1) Rajasthan Glyoxal Ltd., Udaipur (2) Manish Organics India Ltd., Hyderabad	Sponsored
11	Glass Lining	Nataraj Chemical Fabricators, Hyderabad	Non-exclusive
12	RH-8	Unichem Laboratories, Bombay	Collaborative work
13	Hydrazine hydrate	Andhra Farm Chemicals Corp. Ltd., Konur	Non-exclusive

APPENDIX I

PROCESSES THAT HAVE GONE INTO PRODUCTION
(FOR THE FIRST TIME 1980-81)

Sl. No.	Process	Party	Nature of Licence
	Electrochemicals		
CECRI			
14	Phosphating jelly	Executive Engineer, National Highway, Division III, Govt. of Maharashtra	Non-exclusive
15	Corrosion prevention in reinforced concrete and brick construction	-do-	-do-
16	Portland cement coating for steel	-do-	-do-
17	Acid inhibitor in solid form	-do-	-do-
18	Colouring of aluminium powder	A.H. Rollwala Petroleum Pvt. Ltd., Ahmedabad	Sponsored
19	Ni-Mg alloy	Spheroidal Castings Ltd., Madras	Sponsored
	Drugs & Pharmaceuticals		
CDRI			
20	New cervical dilator	Unichem Laboratories Ltd., Bombay	Non-exclusive
	Metallurgy		
NML			
21	Extra fine metal powders by atomisation technique	Nalco Metal Products, Pune	Non-exclusive
22	Aluminium based sacrificial anode for cathodic protection	Aluminium Manufacturing Co. Ltd., Calcutta	Non-exclusive
23	Vanadium pentoxide from alumina sludge	Rare Metals & Chemicals, Ranchi	Non-exclusive
24	Ni-Mg alloy	ABM & Metal Alloys, Shimoga	Non-exclusive
	Materials		
CGCRI			
25	Fibre glass and FRP	(1) Bengal Glass Works, Raniganj, W. Bengal (2) Vikrant Glass Enterprises Pvt. Ltd., Calcutta	Non-exclusive
CMRS			
26	Sealants	Mines Allied Product	Technical aid

APPENDIX I

PROCESSES THAT HAVE GONE INTO PRODUCTION
(FOR THE FIRST TIME 1980-81)

Sl. No.	Process	Party	Nature of Licence
	CRRI		
27	Burnt clay puzzolana	Cimcon Construction Corpn., New Delhi	Non-exclusive
	Machinery		
	CMRS		
28	Safari support	10 firms	Sponsored
	Electronics		
	CEERI		
29	Magnetrons (500 kW to 1.0 MW)	Central Electronics Ltd., New Delhi	Sponsored
30	5 kW RF induction furnace	Pal Industries, NOIDA, UP	Non-exclusive
31	Audio-visual system (dissolved unit)	Central Electronics Ltd., New Delhi	Sponsored
	Instruments		
	CSIO		
32	50 MHZ counter timer	Toshniwal Sperry Ltd., New Delhi	Non-exclusive
	NAL		
33	Bonded wire strain gauges column type load cell	EFGE Load Cells, Bangalore	Non-exclusive
	CSIO		
34	Dissolved oxygen analyser (0-5 ppm)	Naina Electronics (P) Ltd., Chandigrah	Non-exclusive

APPENDIX II

PROCESSES RELEASED TO INDUSTRY
(FOR THE FIRST TIME IN 1980-81)

Sl. No.	Process	Party
	Products of Food Industry, Including Beverages	
	CFTRI, Mysore	
1	Cola flavour blend	Modern Bakeries India, New Delhi
2	Orange and lime/lemon flavour blends	(1) Sauza Industrial Corpn., Puttur (2) Askon Beverages, Calicut
3	Mustard powder	Shri Mangalchand Pagaria, Raipur Marwa
	RRL, Trivandrum	
4	High pungent fraction and colour from Indian chillies oleoresins	(1) Monarch Oleoresins & Spices, Nagpur (2) V.A. Chemicals & Sulphur Industries, Bombay (3) Chilli Exports House Ltd., Virudhnagar
5	Defatted edible coconut gratings	Kera Complex, Irinjalakuda
	Chemicals	
	CLRI	
6	Lacquer CA	HICO Products Ltd., Bombay
7	Synthan NC	Dyes & Dispersing Agents Pvt. Ltd., Bombay
8	Synthan 25 from chrome shavings	Allied Resins & Chemicals Ltd., Calcutta
	NCL	
9	Quinapyramine sulphate & chloride	Chintamani Fine Chemicals, Pune
10	Citrate plasticizers	Sturdia Chemicals, Bombay
	RRL, Jorhat	
11	Swat 104 (flow improver)	(1) Hico Products Ltd., Bombay (2) Hindustan Insecticides Ltd., New Delhi
	Electrochemicals	
	CECRI	
12	Rust converting primer (Sp.)	Rustum Industries, Calicut
13	Red lead-red oxide primer	Bhartiya Paints and Chemicals, Muzzafarpur
	RRL, Bhubaneswar	
14	Electrolytic chromium from chromic acid	Kalinga Chemicals, Cuttack

APPENDIX II

PROCESSES RELEASED TO INDUSTRY
(FOR THE FIRST TIME IN 1980-81)

Sl. No.	Process	Party
	Drugs and Pharmaceuticals	
	CDRI	
15	Bumetanide	Kembiotic Collaborators, Bombay
16	Clofazimine (lamprene)	IDL Chemicals Ltd., Hyderabad
17	Primaquine	IDL Chemicals Ltd., Hyderabad
	IIEM	
18	Research biochemicals	Hy-Grp Chemicals Pvt. Ltd., Calcutta
	Metallurgy	
	RRL, Bhubaneswar	
19	Beneficiation of low grade chromite ores	Orissa Mining Corpn., Bhubaneswar
20	Synthetic titanium dioxide from ilmenite	Larsen & Toubro, Bombay
	Materials	
	CBRI	
21	Automatic reel cutting table	Kusum Engineering Co. Ltd., Calcutta
22	Granular pile foundation	Upkar Fabricators & Engineers Pvt. Ltd., Delhi
	CECRI	
23	Anti-corrosive packaging paper	Shri V. Sundari Mani, Bombay
	CFRI	
24	Formed coke for foundry use	(1) IISCO, Kulti (2) Kalinga Iron Works, Barbil
	CFTRI	
25	Filter pad for groundnut oil to remove aflatoxin	Dey's Medical Stores, Calcutta
	CGCRI	
26	Synthetic mullite and mullite corundrum	Kumardubhi Fireclay & Silica Works, Kumardubhi
27	Sodium silicate from rice husk ash	Industrial Dessicants, Calcutta
28	Lead free white and coloured enamel frits for aluminium	Enamel Nagar Development Corpn., Calcutta
29	High temperature protective enamels for jet-aeroengine components	Hindustan Aeronautics Ltd., Koraput Division, Orissa

APPENDIX II

PROCESSES RELEASED TO INDUSTRY
(FOR THE FIRST TIME IN 1980-81)

Sl. No.	Process	Party
30	Glass ceramic tiles	J.R. Industry, Jamshedpur
	CRRI	
31	Precast concrete block paving	(1) Haryana, PWD (2) Rajasthan, PWD
32	Fully bonded resurfacing/ overlays for rigid pavement	(1) CPWD, (Hyderabad airfield) (2) MES (A defence airfield)
33.	Continuously reinforced concrete pavements with elastic joints	(1) MES (Taxi track for a defence airfield) (2) PWD, Uttar Pradesh
34	Fibre reinforced concrete for paving work	College of Military Engineering, Pune
35.	Resin bonded-concrete blocks for speedy repairs of concrete pavements	MES (A military airfield)
36	Burnt clay puzzolana	Cimcon Construction Corpn., New Delhi
	NPL	
37	Silver powder and silver conducting ink	M/s. Laxmi Traders, Calcutta
38	Carbon thrust bearing	Himachal Carbon, Pawanoo
	RRL, Hyderabad	
39	Briquetting of char fines to obtain shaped smokeless fuel	Industrial Domestic Fuel, Chandrapur
	RRL, Jorhat	
40	Cement-like product from paddy husk	(1) Suraj Cement Works, Bhavani, Patna (2) Patni Industries, Gauhati
	CMRS	
41	Sealants	Mines Allied Products, Dhanbad
	Machinery	
	CFRI	
42	Inexpensive lump coal devolatiser	Eastern Carbons Ltd., Calcutta
	CFTRI	
43	Double cone vacuum drier	One party
44	Tomato juice concentrator	One party
45	Maize mill (blue prints)	4 parties
	CMRS	
46	Quick-setting clamp for cross bar support-design	10 parties

APPENDIX II

PROCESSES RELEASED TO INDUSTRY
(FOR THE FIRST TIME IN 1980-81)

Sl. No.	Process	Party
47	Mine car/tub couplings and draw bar	Bihar Forging Pvt. Ltd., Patna
48	Screw type rigid prop up to 20 tonnes	Union Carbons, Jharia
49	Light duty rigid type steel prop	(1) Jain Industries, Dhanbad (2) Manoj Industries, Dhanbad
	Electronics	
	CEERI	
50	Proximity reception system (Sp.)	Department of Science & Technology, New Delhi
51	1. OHW Mangetron	Central Electronics Ltd., Sahibabad
52	Channel vacoder	RDSO Lucknow
53	16 line telephone exchange	(1) Central Electronics Ltd., Sahibabad (2) BSEDC, Patna
	Instruments	
	NIO	
54	Rotor induction current meter	Saraf Electro Oceanic Appliance, Cochin
55	Tide and wave telemeter	Electronics, Cochin
	NPL	
56	Ceramic enclosed sensors	(1) Swastik Thermometers, New Delhi (2) Naina Electronics, Chandigarh
	NAL	
57	Bonded wire strain gauge column type load cell	EFGE Load Cells, Bangalore
	CSIO	
58	Electromagnetic flow meter	(1) H. Guru Instruments Pvt. Ltd., Calcutta (2) Nivo Controls Pvt. Ltd., Bombay
	CMRS	
59	Device for industrial workers, safety from dust	Safex (India), Dhanbad
	Others	
	CFTRI	
60	Parboiling tank (blue-prints)	3 parties
61	Canning of Rasgolla	Anand Bhandar, Nagpur

APPENDIX III

CSIR PATENTS/APPLICATIONS FILED, ACCEPTED, SEALED
IN INDIA AND ABROAD DURING THE PERIOD 1.4.80 TO 31.3.81

Sl. No.	Name of the Laboratory	INDIA			ABROAD		
		Filed	Accepted	Sealed	Filed	Accepted	Sealed
1	CECRI	31	10	4	—	—	—
2	CDRI	12	1	—	1	—	—
3	NCL	15	5	2	—	—	—
4	CEERI	8	—	—	—	—	—
5	IIP	8	2	—	—	—	—
6	CFRI	4	1	1	—	—	—
7	RRL (Bhubaneswar)	4	2	—	—	—	—
8	CLRI	3	1	1	—	—	—
9	CMERI	3	1	3	—	—	—
10	CRRI	3	1	4	—	—	—
11	CSMCRI	3	—	—	—	—	—
12	NPL	3	1	—	—	—	2
13	RRL (Jorhat)	3	1	3	—	—	—
14	CFTRI	2	—	1	—	—	—
15	CGCRI	2	—	—	—	—	—
16	IIEM	2	1	—	—	—	—
17	NML	2	2	—	—	—	—
18	RRL (Hyderabad)	2	2	—	—	—	—
19	NEERI	2	—	—	—	—	—
20	CMRS	1	—	—	—	—	—
21	NGRI	1	—	—	—	—	—
22	SERC	1	—	—	—	—	—
23	CIMAP	1	—	—	—	—	—
24	NIO	—	1	—	—	—	—
25	NAL	—	—	3	—	—	—
26	MERADO	—	—	1	—	—	—
27	Schemes	1	5	1	—	—	—
	TOTAL	117	37	24	1	—	2

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