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ANNUAL REPORT 1982-83



COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
NEW DELHI

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

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BASIC DATA

National Laboratories/Institutes	...	38
Industrial Research Associations	...	2
Extension Centres/Field Stations, etc.	...	138
Total staff	...	22477
Scientists	...	4161
Other scientific and technical staff	...	10511
Administrative staff	...	3604
Research Committees	...	16
Research schemes in progress	...	539
Emeritus scientists	...	34
Pool scientists (as on 31.1.83)	...	430
Research fellows	...	2958
Processes released to industry	...	52
Processes that have gone into production	...	25
Patents filed	...	78

Budget for 1982-83 (Rs. in lakh)

	Sanctioned estimates	Revised estimates	Actuals
Plan	4220.000	4595.000	4550.289
Non-Plan	5308.170	5595.010	5609.131
Total	9528.170	10190.010	10159.420

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	(IICB)
Central Institute of Medicinal & Aromatic Plants, Lucknow	(CIMAP)
Industrial Toxicology Research Centre, Lucknow	(ITRC)
Centre for Cellular and Molecular Biology, Hyderabad	(CCMB)
Regional Research Laboratory, Jammu	(RRL, Jammu)
Institute for Microbial Technology, Chandigarh	(IMT)
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	(SERC-M)
Structural Engineering Research Centre, Roorkee	(SERC-R)
Regional Research Laboratory, Bhubaneswar	(RRL, Bhu.)
Regional Research Laboratory, Trivandrum	(RRL, Trivandrum)
Regional Research Laboratory, Bhopal	(RRL, Bhopal)
INFORMATION SCIENCE	
Publications & Information Directorate, New Delhi	(PID)
Indian National Scientific Documentation Centre, New Delhi	(INSDOC)
National Institute of Science, Technology and Development Studies, New Delhi	(NISTADS)
INDUSTRIAL RESEARCH ASSOCIATIONS	
Tea Research Association, Calcutta	(TRA)
Electrical Research & Development Association, Bombay	(ERDA)

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INTRODUCTION

The Annual Report of CSIR for 1982-83 highlights the significant achievements of national laboratories in basic research and specific areas of economic importance to the country such as chemicals, resource development, energy, machinery development, agro/bio-technologies, etc. A résumé of the important decisions taken in the meeting of the Society of CSIR held during the year has also been given in the beginning of the report. A new chapter on civil engineering has been introduced. The activities of NISTADS are reported separately. Progress registered in the multi-institutional programmes has been indicated in the sections dealing with the concerned areas.

HIGHLIGHTS 1982-83

IA IMPORTANT INDUSTRIAL ACHIEVEMENTS

Product	Produced by	Production data	Based on technology developed by
Methyl chloro-silanes	M/s Hico Products Ltd., Bombay at Karsundi in Raigarh district, Maharashtra	1000 tonnes per annum Rs. 6 crore capital investment	NCL, Pune
Pesticides			
Monocrotophos	M/s National Organic Chemical Industries Ltd., (NOCIL), Bombay at Lote Parashuram in Ratnagiri district, Maharashtra	500 tonnes per annum Rs. 17 crore includes investment on infrastructure, about 50 per cent	RRL, Hyderabad
Dimethoate	M/s Shaw Wallace Co. Ltd., Calcutta at Haldia	150 tonnes per annum	NCL, Pune
	M/s Mico Farm Chemicals Ltd., Madras at Mettur Dam	100 tonnes per annum	
MBC (methyl benzimidazole carbamate)	M/s JK Business Machines Ltd., Bombay at Ankleshwar	300 tonnes per annum	RRL Hyderabad
Quinalphos and Phosphomidon	M/s Sudarshan Chemicals Industries Ltd., Pune	100 tonnes each per annum	RRL Jorhat & RRL Hyderabad
Insecticide			
Ethion	M/s Shaw Wallace & Co. Ltd., Calcutta at Haldia	100 tonnes per annum	NCL, Pune
Swat 104	M/s Hico Products Ltd.. Bombay at Kapoli	150 tonnes per annum	RRL Jorhat
Products of Food Industry Including Beverages			
Ragi-based weaning food	Titan Protein Food Formulations, Mysore	5 tonnes per day Rs 25 lakh investment	CFTRI, Mysore
Cocoa butter from cocoa mass	Mysore Food and Farm Products (P) Ltd, Bangalore	500 kg/day investment Rs 16 lakh	CFTRI, Mysore
Malted beverage food	Mysore Food and Farm Products (P) Ltd., Bangalore	500 kg/day investment Rs 35 lakh	CFTRI, Mysore
Hops dehydrator	in use by J&K state Agro Industries Development Corporation, Srinagar	60 tonnes of hops in a season	RRL, Jammu

IB OTHER ACHIEVEMENTS

1 Research Vessel *Gaveshani* of NIO, Goa completed 15 cruises in the seas around India. This old ship converted into a research vessel from a second hand hull has an endurance of 15 days, but CSIR has been able to keep her on the seas for an average of 220 days a year.

2 About 28,000 line kilometres of aeromagnetic data were flown in March-April 1982 (NGRI, Hyderabad).

3 The total number of scientific and industrial instruments repaired and/or serviced by the service and maintenance centres of CSIO is 1953. Rs. 223 lakh was the value of these instruments.

4 During the year, 417 scientists were placed in the Scientists' Pool.

5 Two hundered and fifty four (254) CSIR Research Fellows were awarded Post-Doctoral Fellowship on their receiving Ph.D. degree; 338 Fellows submitted their theses for Ph.D.

6 Grants were given to 17 Indian language periodicals primarily devoted to popularization of science through Indian languages.

II SOME SIGNIFICANT SERVICES RENDERED

1 CBRI, at a very short notice, designed and fabricated permanent type of shelters to accommodate members of the Second Indian Expedition to Antarctica.

2 CFRI processed and analyzed more than 31,400 borehole core samples, as a result of which potentialities of new coal areas were revealed.

3 CMRS studies helped the management save over Rs. 30 lakh in destressing.

4 NGRI carried out groundwater surveys in AP & UP.

5 NAL, Bangalore this year conducted 679 blowdowns in its 1.2 m trisonic wind tunnel and provided aerodynamic design data for HAL, ISRO, etc.

6 NML, Jamshedpur in collaboration with BHEL (R&D) continued creep evaluation studies on a number of indigenously produced steels.

7 CFTRI, Mysore analyzed more than 24000 samples of fruit and vegetable products under the Fruit Products Order of the Government of India.

8 CDRI, Lucknow through the DST-supported Regional Sophisticated Instruments Centre carried out analysis of about 3700 samples for research organizations, universities, etc.

9 RRL, Jorhat undertook analysis of 319 samples received from agencies such as North Eastern Hill University, Shillong, Dibrugarh University, etc.

10 NIO, Goa collected valuable meteorological data and continued surveys for the exploration of nodules by deploying its research vessel GAVESHANI. This programme has collaboration with the Department of Ocean Development.

11 CEERI developed TWTs (travelling wave tubes) were used by ISRO in place of imported tubes.

12 NML developed aluminium alloy conductor NML-PM-215 is an effective substitute for conductors made of copper which is imported.

13 RRL, Jorhat has developed a flow improver for pipeline transportation of waxy crudes. These improvers are imported now.

14 CIMAP has demonstrated the use of modern technology for better yield of rose oil and thus helped revive an old industry.

15 RRL, Jorhat has developed process know-how and design package for production of tartaric acid from tamarind leaves, for Karnataka State Forest Industries Corporation, Bangalore.

16 RRL, Jorhat has started introduction and acclimatization of medicinal and aromatic plants at Itanagar, Arunachal Pradesh.

17 NML has designed and demonstrated the use of a special cupola for use by foundries and rerolling mills at Agra so that pollution is brought down.

18 CBRI has developed a process for manufacture of building bricks from plastic black and red soils, thus conserving the use of top soils for brick manufacture.

19 SERC Madras has fabricated prototypes of cyclone resistant core units for huts along the coastal areas of Tamil Nadu. This work was sponsored by the State Government.

20 CMERI has developed a device for removing illegally parked vehicles for the use of the Police Department.

21 IIP undertook process design work jointly with Engineers India Ltd. on behalf of Bharat Petroleum Corporation and Indian Oil Corporation.

22 CLRI collaborated with Balmer Lawrie, Calcutta for scaling up of processes for production of synthetic fat liquors.

23 RRL (H) and RRL (J) provided training to staff and technical assistance to the Housing and Building Research Institute, Dhaka, Bangladesh for a 50 kg/day prototype plant for production of paper boards from water hyacinth.

24 CFTRI has designed a 0.5 tonne/hour capacity plant for dehusking of winged bean for the Food Research Institute, Ghana, Accra.

25 RRL (Bhu), NML are working on methods of winning metals from polymetallic nodules, This has immense potential for future recovery of metals like copper, cobalt and nickel from nodules from the sea.

26 RRL (Bhu) has developed and offered process know-how for the beneficiation of low grade chromite for the charge Chrome Plant (at Bhadrak, Orissa) of M/s Ferro Alloys Corporation, Andhra Pradesh.

III MAJOR CSIR-SAIL COLLABORATION PROGRAMMES

S. No	Title of the project	Time schedule		Lead laboratory
1.	Optimisation and control of blend proportion of different coals at steel plant washeries based on petrographic characterisation.	12/82	06/85	CFRI
E.2.	Column floatation technique	01/82	12/84	RRL (Bhu)
E.3.	Recovery of metallurgical coal from high ash washery middlings by incorporating 10 tph oil agglomeration plant at DSP washery.	01/82	12/84	CFRI
4.	Development of steels for cryogenic application	06/82	04/84	NML
E.5.	Development of direct reduction processes using iron-ore coal agglomerates.	03/82	12/84	NML
6.	Evaluation of the use of pre-reduced metal in LD converter	01/82	12/84	NML
7.	Development of hot rolling oils	01/82	12/86	IIP
8.	Development of Combustion System using oil-water emulsion for conservation of furnace oil.	04/82	12/84	RRL (Bhu)

E—Engineering Consultancy involved.

IV MAJOR SPONSORED RESEARCH PROGRAMMES

S.No	Title	Sponsoring authority	Contract value as per agreement (Rs. in lakh)	Remarks
1	2	3	4	5
CECRI				
1.	Corrosion and corrosion protection of concrete bridges in marine environment	Ministry of Shipping & Transport (Road Wing) Bridges	7.115	
CEERI				
2.	Solar panel for solar cell	Department of Science & Technology (DST), New Delhi	20.220	
3.	Scanning electron microscope	-do-	11.985	
4.	Process control instrumentation for sugar industry	Electronics Commission	14.320	Completed

1	2	3	4	5
5.	Development of 6.0 GHz, 20 W TWT	ISRO	11.000	
CGCRI				
1.	Fracture of nitrides and carbides of silicon	ARDB Ministry of Defence	9.50	
CLRI				
1.	Formulations (upscaling) for manufacture of synthetic fat liquors	Balmer and Lawrie Calcutta	6.25	Completed
CSIO				
1.	Scanning electron microscope	DST, New Delhi	10.630	
2.	Panoramic aerial camera	Ministry of Defence, New Delhi	22.550	
3.	Design, development and fabrication of digital and analog seismograph	Department of Electronics, New Delhi	11.390	
4.	Design, development, fabrication and supply of low resolution camera lenses & medium resolution camera lenses for linear image self-scanning camera	Space Applications Centre, Ahmedabad	12.500	New
ITRC				
1.	Biochemical effects of particulate air pollutants on lungs	Indo-US Bilateral co-operational programme in environmental pollution	10.78	
2.	Integrated environmental programme on heavy metals	Department of Environment	11.05	
NAL				
1.	Base flow facility	ARDB	9.250	
2.	Utilisation of sludge gas for operation of gas turbine engine	DST	13.748	
3.	Film cooling studies of turbine blade cascade	ARDB	13.185	
4.	Electrochemical milling machine	ARDB	23.000	
5.	R&D of titanium base alloys for compressor blade and disc application in gas turbine	ARDB	10.220	
6.	Computerisation of the full scale fatigue testing facility at NAL	ARDB	34.200	
7.	Direct digital test system for vibration studies of aircraft structures and development of associated data reduction techniques	ARDB	24.600	

1	2	3	4	5
8.	Metal capsule development programme	DLRL	94.50	
9.	Establishment of a facility for high intensity acoustic testing of space crafts	ISRO	176.76	
NCL				
1.	Hydroxy terminated polybutadiene	ERDL, Pune	12.53	
NEERI				
1.	Analysis, assessment and treatment of toxic dischargas from phosphatic fertilizer and basic organic chemical industries	EPA; USA Indo-US-502	12.920	
2.	Impact of fugitive and stack emissions from selected industries on neighbourhood air quality	EPA, USA Indo-US-501	26.91	
NIO				
1.	Submarine pipeline surveys for pipeline route from Daman to Umbergaon	ONGC	10.00	Completed
2.	Analysis of seabed sediment samples along the submarine pipeline route off Gujarat	ONGC	10.650	Completed
3.	Submarine pipeline route surveys from Bassein to Gujarat	ONGC	25.00	Completed
4.	Biofouling of the offshore platforms	ONGC	12.00	Completed
5.	Selection of site for waste water disposal and unloading facility for fertilizer plant of Thal (Phase II)	RCFL (Bombay)	11.748	
6.	Collection and analysis of wave data off the east coast	ONGC	17.30	
7.	Current and wave observation along sub-sea pipeline from Bassein to Umbhrat on west coast of India	ONGC	52.269	
NML				
1.	Bench and pilot plant scale beneficiation studies on iron ore slimes from Bihar-Orissa region	Mineral Development Board, Govt. of India, New Delhi	5.445	New
2.	Beneficiation and agglomeration of iron ore samples from Daitari and Gandhamardhan (10 type samples) for Paradeep Steel Projects, etc.	MECON, Ranchi for SAIL	6.949	

HIGHLIGHTS 1982-83

1	2	3	4	5
NPL				
1.	Development of interference filter in wavelength region 0.45 to 1.0 micron	ISRO, Ahmedabad	5.97	
RRL, Bhubaneswar				
1.	Solar grade silicon by hot metal solvent extraction and directional solidification	DST, New Delhi	14.00	
RRL, Hyderabad				
1.	Process for epichlorohydrin and design of prototype plant	Metazinc Pvt. Ltd., Bombay	17.00	
SERC, Madras				
1.	Development of computer software for the analysis and design of ship structure	Hindustan Shipyard Ltd., Visakhapatnam	6.00	Completed
2.	Development of designs for Light beacons using precast modular construction	Department of Light-houses & Lightships, Ministry of Shipping & Transport, New Delhi	3.50	
		Total:	808.944	

V SOME COLLABORATIVE PROJECTS

1 A memorandum of understanding was signed between ISRO/DOS and NAL/CSIR on 27 January 1983 through which NAL will set up an acoustic test facility for the Department of Space.

2 The project for the establishment of a fully automatic tower testing and research station is making rapid progress. This is being established by SERC(M) with technical collaboration from the British Electricity International of U.K.

3 RRL (Bhu) has undertaken pilot plant studies on the following two projects:
(a) Beneficiation and extraction of copper, lead and zinc from complex sulphides; and
(b) Beneficiation and agglomeration of chromite ore fines in collaboration with GTZ, West Germany with 50-50% financial involvement for the projects.

Some Abbreviations

ARDB	:	Aeronautical Research & Development Board
HAL	:	Hindustan Aeronautics Limited
ISRO	:	Indian Space Research Organization
BHEL	:	Bharat Heavy Electricals Limited
DST	:	Department of Science & Technology
SAIL	:	Steel Authority of India Limited
ERDL	:	Electronics Research & Development Laboratory
ONGC	:	Oil & Natural Gas Commission
RCFL	:	Rashtriya Chemicals & Fertilizers Limited
MECON	:	Metallurgical & Engineering Consultants
NIN	:	National Institute of Nutrition
VCRC	:	Vector Control Research Centre

CSIR SOCIETY

A meeting of the Society of CSIR was held on 3 November 1982. President of CSIR, Smt. Indira Gandhi, presided.

A résumé of the important decisions taken in this meeting is given below.

1 DGSIR made a statement drawing particular attention to
(i) linkages with industry and the ministries;
(ii) need for more funding for critical areas; and
(iii) personnel policies.

2 The audited annual accounts of CSIR for the year 1980-81 and audit report thereon were adopted by the Society.

3 While considering the Annual Report for the year 1980-81, members complimented CSIR for the excellent work done by it during the last year and offered suggestions on several matters. These related to linkages between CSIR and industries, work on post-harvest technology, linkages between CSIR and universities, excellence in electronics, utilization of indigenous ores of low quality and coal with high ash content, work on anti-fertility and leprosy control, work on genetic engineering, production and utilization of biomass and the need for a ten-year perspective plan with defined targets.

4 President, CSIR observed that there was need for greater utilization of the work done by CSIR and specially the technology generated by it. She was glad to know about the increasing cooperation between CSIR and the university system. We should not only think of what universities could do for us but also what we could do for the universities for improving the quality of education. There was a close linkage between the development of educational system and development of capabilities in the R&D system. She was glad that CSIR was laying emphasis on having a programme of providing houses for its scientists.

5 Thereafter the Annual Report of the CSIR for the year 1981-82 was adopted.

RESEARCH UTILIZATION AT A GLANCE

During the year, 25 new processes went into production (Appendix I) and 52 processes were released to the industry (Appendix II). The total number of processes released to industry till the end of the year was 1400; of these, 622 processes were reported to be in production. A pilot plant for the production of paper roofing sheet (CBRI/RRL Jorhat) was set up in Burma for the Central Research Organization, Rangoon under the TEC Programme.

Rs. 1501.76 lakh was the contract value of the 718 sponsored research projects in operation during the year in CSIR laboratories. Of these, 208 were completed. (This does not include Rs. 463 lakh provided by the Department of Ocean Development as complementary funds for NIO programmes.)

The laboratories had 478 consultancy assignments valued at more than Rs. 218.17 lakh. One hundred and ninety-seven assignments were completed.

During the year, 78 patents were filed; 57 patents were accepted and 28 sealed in India (Appendix III). Fifteen patents were filed abroad.

Premia/royalties received for the last three years were as follows:

(Rs. in lakh)

Year	1980-81	1981-82	1982-83
Premia	4.120	5.280	8.280
Royalties	56.912	75.368	40.490
Total	61.032	80.648	48.770

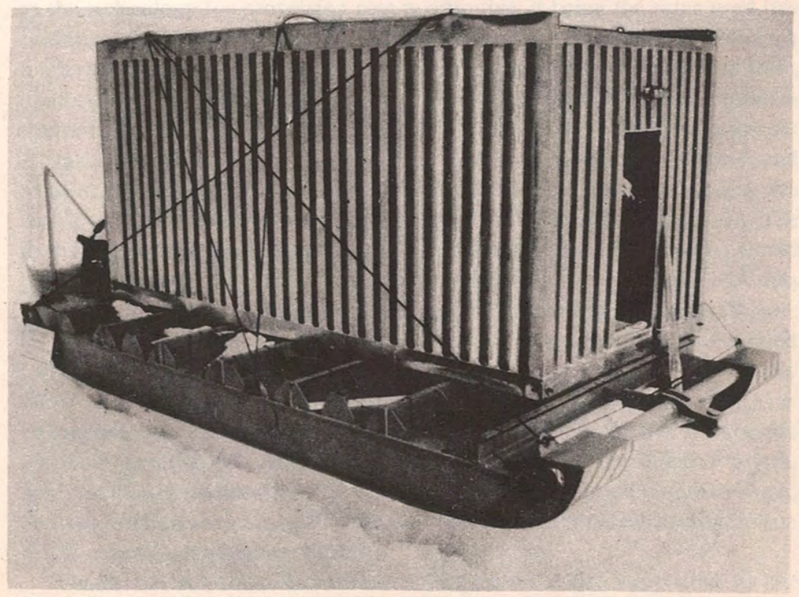
SECOND INDIAN ANTARCTIC EXPEDITION

Prefabricated Shelter for Antarctica

CBRI designed and fabricated permanent type of shelters to accommodate 28 members of the Second Indian Expedition to Antarctica (1 December 1982 to 21 March 1983).

The structural system of these shelters consists of 3 m long (overall maximum dimensions) structural aluminium alloy sections, broken into smaller lengths for ease in transportation. The total weight of the structural components of each shelter having a floor area of about 24 sq. m. is about 1550 kg only, while none of the individual components (including S.S. nuts and bolts) weighs more than 25 kg. Fibreglass reinforced plastic sheet (2.5 mm thick) has been used as thermal insulating layer, while plastic coated laminated teak ply has been used as the inner face of these composite panels. The total weight of the floor, wall and roof panels for each shelter is of the order of 2 tonnes, while none of the panels weighs more than 40 kg.

The shelters have been provided anchorage by driving stainless steel spikes through holes in 32 mm thick plates welded to the base of the columns. Further, polysulphide putty is used *in situ* to close all possible gaps between different building components to make the whole structure airtight.



A view of the shelter fabricated by CBRI for the Second Antarctic Expedition

ANTARCTIC EXPEDITION

The project (including fabrication) was completed in a record time of 50 days by a team of CBRI scientists. According to the reports available, both structures have been successfully erected by the expedition team at Antarctica.

Other Experiments

The experiments contributed by NPL related to (i) study of time dissemination via HF and VLF, with special reference to NPL's standard time broadcast under the Call Sign 'ATA', (ii) studies in the areas of communication and propagation of radio waves through the ionosphere, (iii) radio meteorology measurements using automatic weather station for surface-based duct studies relevant to marine microwave communications, and (iv) study of air-sea interaction and energy exchange.

CONTRIBUTIONS TOWARDS RURAL DEVELOPMENT AND DEVELOPMENT OF BACKWARD AREAS

Under a survey sponsored by the Central Public Health & Environmental Engineering Organisation (CPHEEO), New Delhi, a comprehensive evaluation of rural water supply schemes in India has been completed by NEERI. The survey covered 66 villages in 11 states, including Andhra Pradesh, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. In addition, 17 reference villages with no organised water supply were surveyed to compare the health status of the community. Representative rural water supply schemes were critically evaluated with a view to identifying technological, administrative and socio-economic constraints in effective implementation, operation and maintenance to give the desired benefit to the rural population.

A 200 kg grass holding capacity distillation plant for lemongrass distillation was fabricated and supplied by RRL, Jorhat to the Government of Arunachal Pradesh. The plant was installed at Lumia, a remote place in Kameng District, Arunachal Pradesh in October 1982.

Oil of rose, obtained from *Rosa damascena* Mill., is the most valuable essential oil in perfumery and it is being produced in Bulgaria, USSR, Turkey and Morocco. The crop is being cultivated on a large scale in Uttar Pradesh, mainly in the district of Aligarh. Although rose water and rose oil have been produced in Uttar Pradesh for the last 500 years, the industry has been dying, as the technology for processing rose is primitive, it being the same used five centuries ago. There was, thus, an urgent need for the development of a modern and efficient technology for rose oil production. Keeping this in view, a pilot plant for extraction of rose oil of capacity 25 kg rose flowers per batch was designed, fabricated and installed by CIMAP at village Hasayan in district Aligarh. The oil was obtained in a yield of 0.018% and quality of oil was found to be at par with the Bulgarian rose oil. Based on these data, the process was scaled to 125 kg flowers/batch and a yield of 0.030% has been obtained. The technology is being purchased by the Agra Mandal Vikas Nigam who would put up a commercial plant. It may be mentioned that the present work was carried out at Aligarh in collaboration with the Agra Mandal Vikas Nigam.

The RRL (Jorhat) branch at Itanagar, Arunachal Pradesh, has started introduction and acclimatization of medicinal and aromatic plants, viz. *Dioscorea floribunda*, *Mentha* spp., *Chamomilla*, *Cymbopogon* spp., i.e. palmarosa, lemongrass, *Java citronella*. Other activities of this branch are chemical analysis of medicinal plants occurring in Arunachal Pradesh, analyses of soil samples for finding their suitability for brick manufacturing, analysis of blue pine resin of Zire District of Arunachal Pradesh and operation of the seismic surveillance station.

Under the All India Coordinated Project on Algae supported by the Department of Science & Technology, a procedure was worked out by CFTRI for the cultivation of protein-rich blue green alga, *Spirulina platensis*, in fresh

water, initially for use in animal feeds. Data have been generated by conducting trials in open ponds with exposed surface area of 450 m^2. The cultivation procedure does not involve electrical energy and use of cost-intensive equipment. The alga can be manually harvested in 8 days, filtered over cloth and dried in sun to a moisture level of 8-10 per cent in 6-8 hours. This blue green alga is rich in B-complex vitamins. In a novel approach made under this study, the poultry farm residues can be digested for producing gas and the effluent utilized as nutrient for cultivating this alga in an integrated system.

The Rural Sanitation Project of NEERI, Nagpur has entered the eighth year. Under this project, construction of low cost latrines, health education, deworming and studies on health impact are being carried out in ten project villages near Nagpur. The Nagpur Zilla Parishad is collaborating in this project. A one-day training course on Rural Sanitation was organised on 17 August 1982 for gram sevaks, Community Health Workers and village sarpanchas from the 10 project villages. This was followed by a seminar-cum-workshop on 'Low Cost Sanitation' on 19-20 February 1983 at NEERI in which 150 participants from all over Maharashtra State were present.

As a part of the project sponsored by the Ministry of Rural Development, Government of India, a field station at Bankura was established by CSIR to bridge the gap between technology generation and its application in rural areas through a creative interaction between the scientists and rural artisans. The objectives of the project are:

(a) development and demonstration of specific rural technologies and promotion of their utilization by artisan cooperatives;
(b) understanding of existing techniques of artisans and improvements thereof;
(c) initiation at laboratory level of new designs, developments and demonstrations relevant to rural needs;
(d) development of rural production and market structure through utilization of S&T knowledge;
(e) training of artisans—technical, economic and managerial—for running cooperatives; and
(f) assistance to artisans for development of production and market organizations.

NML has assisted the rural artisans of Bankura district in West Bengal, towards the improvement and modification of conventional castings and heat treatment of metals and alloys. NML scientists demonstrated on the spot techniques for improvement of their products.

RRL, Jorhat staff stationed at Yaongyimsen sub-station, Nagaland have imparted training on agrotechnologies on *Java citronella* and *Eucalyptus citriodora* and initiated commercial cultivation and distillation of *E. citriodora* at Yaongyimsen village.

RESOURCE DEVELOPMENT—COAL AND OTHER MINERALS

Coal

A total of about 13000 metres of coal core length from 746 boreholes spreading over 122 prospecting blocks in over 40 different coalfields were processed and more than 31,400 borehole core samples analysed by CFRI. Besides these, about 4800 coal samples were analysed for physical and chemical surveys of working collieries and as an aid to industries and to the Indian Railways. The results of the analyses of the borehole coal samples have been communicated to the drilling organizations like Central Mine Planning & Design Institute Ltd. (CMPDIL), Geological Survey of India (GSI), Metallurgical and Engineering Consultants, etc. The work has unravelled the potentialities of several new coal areas.

The first trial in India of the use of formed coke in the production of low phosphorus pig iron was undertaken in the 130 tonnes/day low shaft furnace of M/s Kaligna Iron Works, Barbil, Orissa. For this purpose, 100 tonnes of formed coke were produced at CFRI according to CFRI process using non-coking coals from Madhya Pradesh (Chirimiri and Churcha area) having low phosphorus content and then transported to Barbil. In the trial runs starting with 25 per cent replacement of normal coke by the formed coke, the replacement was increased in stages to 75 per cent. During the trial period, the furnace operation was normal and consistent. No operational trouble was encountered. The trials indicated the suitability of usage of formed coke in low shaft furnaces as well as for the production of low phosphorus pig iron.

Consequent on the development of a process on chemical demineralization of coal for production of low ash coal, CFRI has entered into a technical collaboration agreement with M/s Premium Coke Manufacturing Company, Dhanbad for joint pilot plant development and study of the process. A process package know-how has been supplied to a consulting engineering firm for installation and commissioning of a 3-tpd plant on behalf of the Company.

CFRI conducted detailed carbonisation tests in the laboratory and the pilot plant for selection of an optimum coking blend for use in large capacity blast furnaces of the Visakhapatnam Steel Plant using 20-30 per cent imported prime coking coal in admixture with indigenous coals. Tests have been completed with samples of raw coals from different sources linked to the proposed washeries which are planned to supply washed coals to the steel plant. The work was sponsored by the Steel Authority of India Ltd. (SAIL). The complete report with test results and recommendations has been forwarded to the sponsor. In order to restrict the use of imported coking coal to 30 per cent, the indigenous coking coal should be of good quality and the coking blend be crushed 100 per cent through 3 mm.

Investigation was carried out into the slope angle determination and stabilization of the hill slope over a crusher house at Meghahataburu where a debris type landslide took place in July 1980. As ground displacement records

did not indicate any movement, it was concluded that the landslide was probably a 'debris avalanchi'. Based on the investigations, necessary recommendations were sent by CMRS to the management. These helped the management save over Rs.30 lakh in destressing.

For the Dugda coal washery of SAIL, a design for safe stacking of washed fine coking coal of low moisture was provided by CMRS. A stack height of 20 m can be reached with this design, although the theoretically calculated height is only 3 m.

Drivage of main dip and companion dip headings beyond 27 L in Kargali top seam in Sawang colliery of Central Coalfields Ltd. (CCL) had to be suspended since 1978 due to high influx of methane from the seam. CMRS has installed an in-seam degasification plant at the mine. At present, with two drainage holes, methane (91 per cent) is being discharged at the main return at the rate of 315 litres/min. As a result, it has been possible to drive two headings safely.

Ventilation investigation was carried out by CMRS in three mines, namely Chasnala, Moonidih and Jealgora to assess the existing ventilation standard and to suggest a suitable ventilation system for providing improved working environment to the workers. Ventilation planning was also done for Seetalpur and Bankola collieries to meet the future production target.

Other Minerals

The Prime Minister dedicated to the nation (on 12 November 1982) the 6000 tpd copper concentrator at Malajkhand. The processes were piloted in NML to produce concentrates containing 25 per cent copper from an ore containing only 1 per cent copper. The recovery of copper from the concentrates was 96 per cent plus. Based on this work, the process flowsheets were prepared by NML. Hindustan Copper appointed M/s Mechanober Laboratories of USSR as consultants to prepare the detailed project report. The Consultants and Engineers India Ltd. sized the equipment in consultation with NML. The plant has been put up with the engineering work done by Engineers India Ltd.

About 1 tonne of tin ore concentrate containing niobium and tantalum was received from the Atomic Minerals Division, Hyderabad. These concentrates were obtained from the recently discovered tin ore deposits of Bastar district of Madhya Pradesh. Experiments on bench and laboratory scale were successfully carried out by NML to recover tin with more than 95 per cent recovery. Negotiation is in progress with the Madhya Pradesh Government for commercial exploitation of tin deposits for recovery of tin, while niobium-enriched slag will be processed by the Atomic Minerals Division.

In a collaborative project between RRL-Bhubaneswar and M/s Engineers India Ltd., on transportation of coal and other minerals in water slurry through pipelines—a cheaper mode of transport in comparison to rail or

road—the installation of 25,50,100 and 150 mm diameter and 100 and 200 metres long test loops consisting of slurry tanks, a slurry pump, DC motors and thyristor drive system, magnetic flow meters, measuring tanks and other measuring instruments in the line, has been completed. Hydraulic tests and water run were conducted to establish the system performance for pressure, flow rate and power.

Based on the technology and pan sintering unit developed by RRL(Bhubaneswar) for sintering of iron ore fines at Kalinga Iron Works, Barbil, Orissa, in a collaborative project of RRL (Bhubaneswar) and Mineral Development Board, Government of India, a few hundred tonnes of manganese ore fines were sintered and assessment of their suitability for production of ferro-manganese was successfully carried out at Ferromanganese Plant of TISCO, Joda, Orissa. This investigation leads to conservation and utilization of large quantities of manganese ore fines generated at mine sites.

Glass & Ceramics

It was reported earlier that CGCRI had developed high alumina ceramics containing 92 per cent Al_2O_3. The work has been further extended recently and three more compositions containing 95 to 99.9 per cent Al_2O_3 have been developed. The entire spectrum of alumina ceramics can now be covered with these new compositions and those developed earlier. While the 95 per cent Al_2O_3 containing body is useful for thick film substrates and for various other electronic and electrical grade ceramics, 95 per cent alumina-titania body is specially suited for extrusion of various items for engineering and electrical applications, and the 99.9 per cent alumina body is used in electrical, electronic and engineering industries and also as nuclear ceramics.

Groundwater Exploration and Management

Groundwater surveys were carried out by NGRI in the state of U.P. for M/s U.P. State Cement Corporation Ltd., Chunnar, Mirzapur district. About 7 groundwater surveys were carried out in A.P. at the request of private and government agencies.

A two-year study on performance evaluation of water treatment plants in India has been completed by NEERI. Altogether 20 plants of various types in the range 0.1 MGD to 59 MGD were evaluated. The study revealed that most of the plants are operated and maintained by personnel who have had no formal training. Laboratory facilities were absent even in large plants.

ELECTRONICS AND INSTRUMENTATION

Electronic Devices

Development of a 6.0 GHz 20 W Travelling Wave Tube (TWT) has been completed by CEERI under a grants-in-aid project supported by the Indian Space Research Organisation (ISRO). These tubes are used as microwave amplifiers either in the driver stages of high-power earth stations for satellite communications, or in the output stages of emergency/transportable terminals for satellite communication systems. Two CEERI-developed TWTs have been in satisfactory use in ISRO's earth stations in place of equivalent imported ones for various communication experiments via the APPLE satellite and have, between them, logged nearly 4000 hrs of operation.

Electronic Systems

Under an R&D programme funded by DoE, CEERI has developed micro-processor based monitoring systems for mine winder which is used for transporting personnel and material. The CEERI electronic monitoring system is an 'Add-on' system to the existing arrangement used for monitoring of speed and depth of movement of the cage. Power is cut off in case of overspeeding and wind to ensure the safety of personnel. The system has undergone field trials successfully at Kargali Coal Mines.

Instrumentation

An automatic temperature data acquisition, display and monitoring system (using digital techniques) for 24 temperature points has been designed and developed by CEERI. The system has been tried out successfully for more than two months in a commercial sugar factory resulting in saving of energy consumption. Another prototype of this system covering larger number of points is installed in a factory in UP and is working satisfactorily. A direct reading instrument for determining instantaneous corrosion rate of metals has been developed and tried out by CEERI Extension Centre, Madras. The accuracy of the measuring system has been checked using accelerated test methods.

NAL has fabricated and supplied an envelope detector to Bharat Heavy Electricals Limited, Hyderabad for analysis of vibration signals, generated by faulty bearings. It is a powerful tool working on the principle of mixing two signals and detecting the wanted signal. The instrument consists of a voltage control oscillator, mixer, an IF amplifier, filter, a detector and a variable cut-off low-pass filter.

NAL has transferred the know-how on the following analytical instruments developed in the laboratory to M/s Elico Pvt. Ltd., Hyderabad through the NRDC.

(i) charging current compensated DC polarograph,
(ii) charging current eliminated AC polargraph, and

(iii) phase selective and harmonic polarograph.

The transfer of know-how involved transfer of all technical details and specifications of the instruments (technical document), providing technical training to the engineers of the company and fabrication of prototype of one of the units.

A fully engineered prototype analog seismograph has been designed, developed and fabricated by CSIO. The instrument finds extensive applications in the study of geokinematics of a region by monitoring and recording micro-earthquakes, in detection and location of atomic explosions, in oil exploration, in investigations of earth structure for heavy building construction and in other such fields. The instrument is capable of processing low frequency, low amplitude noise-corrupted signal from a seismic sensor and recording the information on a smoked paper for a maximum period of 115 hrs. The unit is sufficiently rugged for unattended field operation. The instrument has been developed as a part of a sponsored programme from the Department of Electronics, Government of India.

A laboratory prototype furnace temperature controller based on a microprocessor has been designed and developed. Experiments conducted on a 10 kW furnace have shown that the temperature can be controlled with an accuracy of $\pm$ 1°C. This unit has been developed by CSIO as one of the simulation models of the process control equipment.

A laboratory prototype multigrain moisture meter based on EPROM for four grains, viz. maize, wheat, paddy and soyabean, has been completed at CSIO. It is capable of giving direct reading of the moisture content in the grain without referring to charts. In order to increase the range of the instrument to cover a variety of grains, viz. oilseeds like cotton, mustard, etc., and also to compensate for effective environmental parameters like relative humidity, temperature, development work has been initiated on a microprocessor-based multigrain moisture meter.

Another significant achievement of CSIO is the development of a haemodialysis machine. The machine provides a continuous supply of a solution (dialysate) of controlled concentration at the right temperature and pressure to the dialyser. About 300 litres of dialysate is required for one patient. To avoid any storage problem, a large quantity of the concentrate is kept in a container and then mixed with filter-fed water. The flow of water is directed to the proportionating pump, which is designed to ensure controlled flow of the dialysate to the dialyser. The machine has undergone successful trials at the PGI, Chandigarh.

The design, development, prototype fabrication and testing of a comprehensive range of profile projection objectives of stringent specifications have been completed by CSIO. M/s Madras Dial Gauges & Measuring

Instruments Company, Bangalore, sponsors of the project, critically evaluated these objectives *vis-à-vis* Dallmayer lenses and approved the prototypes.

A laboratory prototype wavelength dispersive X-ray spectrometer has been completed by CSIO. The instrument has been rigorously tested and the results are repeatable. In order to establish its resolution, a sample of five adjacent elements of the periodic table, namely Fe, Co, Ni, Cu and Zn was analysed and well separated peaks were recorded. For quantitative analysis, samples of stainless steel and brass were taken and the results obtained were within a limit of 1 per cent.

A laboratory prototype atomic absorption spectrophotometer has been completed. It has been tested by CSIO over long periods for stability and repeatability of the results. Analysis of elements like Mg, Cu, Pb, Ca and Na which cover the entire range of wavelengths of this instrument has been tried. Sensitivities achieved were comparable with those quoted in the literature.

Work on the design development of combined electron spectroscopy for chemical analysis (ESCA), auger electron spectrometer (AES), ion scattering spectrometer (ISS) and work function measuring unit was pursued by CSIO. Most of the accessories for these instruments have been developed. The design development of electron optical bench, X,Y,Z and rotation type target holder with flipping facilities, 15 kV/0.5 mA supply for multi-target X-ray tube and accessory electronics for ESCA and another compact design of electronics for AES have been completed.

Know-how of instruments such as ultrasonic hardness tester, sampling gun, direct reading mechanical dilatometer, 180 mm f 5 wide angle photocopying lens and high strength copper base alloy was released by CSIO to the industry for commercial exploitation.

The prototype of a new portable proton precision magnetometer for mineral exploration work has been designed and fabricated by NGRI. The instrument is designed to measure the total intensity of magnetic field over the range of 20,000-70,000 gammas with a sensitivity of 1 gamma. NGRI has already developed proton precision magnetometers for airborne and ship-borne surveys. The speciality of this magnetometer lies in its compactness, light weight (1.25 kg) and low power consumption.

An improved ultrasonic method called the Compensated Ultrasonic Timer Technique (CUTT) for the measurement of wave velocities in rocks and other solids has been developed by NGRI. This device cuts short on the time for velocity measurements as well as on the cost in comparison with the pulse transmission instruments.

An interlocking ultrasonic test jig, a device for the determination of wave velocity and amplitude in rock core specimens and other solids in their ambient state, has been developed.

Three proton magnetometers, two magnetic susceptibility meters, one seismic timer and one metal detector have been sold amounting to Rs.11,870. A total of 70 instruments were repaired by NGRI.

CBRI has developed a versatile sub-soil deformeter which is capable of assessing the strength and deformation behaviour of ground at different depths down a borehole. The existing procedures in the country, at best, lead to evaluation of soil behaviour only at the condition of failure. Before the development of the unit, import of Menard pressure-meter from France was the only alternative. Nearly a dozen sets of this device have already been sold in India and about half as many overseas. The development was the result of an intensive collaboration with Associated Instruments Manufacturers (I) Pvt. Ltd. involving work spanning over three years.

The device marks an improvement over the French alternative, without altering the basic features or operational principle. Its operation is simpler and constitution entirely indigenous, except for the membranes.

A corrosion measurement console has been installed at CECRI. This is a versatile instrument for corrosion measurement and is capable of many complex corrosion measurements. A programme of measurement is fed to this instrument operated by means of a 16-bit micro-processor built into it and the results are displayed on a chart.

An oceanographic data buoy system for offshore meteorological observations has been designed, developed and deployed off Mormugao Harbour by NIO. This buoy is a circular array of equally-spaced high density polyethylene cylinders providing a total buoyancy of 2200 kg. The system works on sealed lead acid batteries which are re-chargeable by an array of solar cells. Data on wind speed and direction, air, surface and buoy compartment temperatures, relative humidity, etc. are acquired at hourly intervals and stored on EPROMS (Erasable Programmable Read Only Memories) for further analysis on-shore.

An electronic bathythermograph has been designed by NIO to replace the mechanical BT with added advantage of having data storage and readout facility. Temperature data at every 1 m depth is stored on single micro-computer chip with 2 k × 8 bit memory.

Prior to every cast, the instrument is fed with the station number, date and the maximum operating depth and BT data are accordingly collected. The system works on rechargeable batteries incorporated in the underwater unit.

NIO has designed a new and improved version of Rotor Induction Current Meter called Rotor Current Meter. The unit has been designed to display both speed and direction and it works on 12 V battery.

CHEMICALS

Drugs and Pharmaceuticals, Pesticides and Other Chemicals

On a request from CMPDIL, the possibility of utilizing Assam Coal for making pellet coke has been studied in CFRI. Following detailed laboratory tests, bulk quantity of pellets was prepared from Assam coal. The green pellets were devolatilized in a continuous vertical shaft devolatilizer. The product has been found to be suitable for use as domestic fuel. The report of the investigation has been submitted to the sponsor.

The process for the production of 1-ephedrine hydrochloride, developed earlier by CDRI, was handed over to Maize Products, Ahmedabad and the process was demonstrated using indigenously manufactured benzaldehyde for production of the intermediate 1-acetylphenylcarbinol.

Work on a two-step process for pralidoxime methiodide (an antidote to pesticide poisoning) from alpha-picoline has been completed by CDRI; the project was sponsored by Unichem Laboratories Ltd., Bombay.

Laboratory scale processes have been standardised by CDRI for the preparation of lidamidine (antidiarrhoeal) from 2,6-xylidine and of amoxycillin (antibiotic) from 6-APA. A simple method for the preparation of nitriles from the corresponding bromides, using sodium nitrile and benzyltriethylammonium chloride, has been developed.

A modified process for the manufacture of vitamin B_6 which has been released to Indian Drugs and Pharmaceuticals Ltd., Hyderabad, has now been released by NCL to another party, viz. M/s Lupin Laboratories Ltd., Bombay for commercial production. At present about 40 tonnes of vitamin B_6 are being imported in the country. Indigenous production of vitamin B_6 from these two plants (about 80 tonnes) will effect a saving in foreign exchange to the tune of Rs.3.2 crore per annum.

A process has been standardised by CDRI for large scale production of spores of *Bacillus thringiensis*, a mosquito larvicide. The composition of the culture medium has been modified to reduce the production cost. The material is being regularly supplied to the Vector Control Research Centre, Pondicherry, for carrying out field trials.

Ibuprofen is one of the widely used analgesic and antiinflammatory drugs. The present demand for this drug is estimated to be around 40 tonnes per annum, which is expected to go up to 100 tonnes. A process for the preparation of this drug has been developed on behalf of M/s CIPLA, Bombay on sponsored basis. This work, carried out at NCL, has led to the development of an innovative technology different from the one presently employed by a multinational pharmaceutical company in this country. CIPLA who have successfully carried out pilot plant production of this drug are expected to commence commercial production by December 1983 at the rate of 1 tonne per month. The annual turnover of this production will be around Rs.1.3 crore.

At Lote Parashuram in Ratnagiri district M/s National Organic Chemical Industries Ltd. (NOCIL), Bombay have commissioned their 500 TPA unit for the production of monocrotophos based on the technology and process engineering package provided by RRL(H). The unit has gone into commercial production. A pilot plant to produce 25 kg. per batch was earlier installed, commissioned and demonstrated to NOCIL by RRL(H).

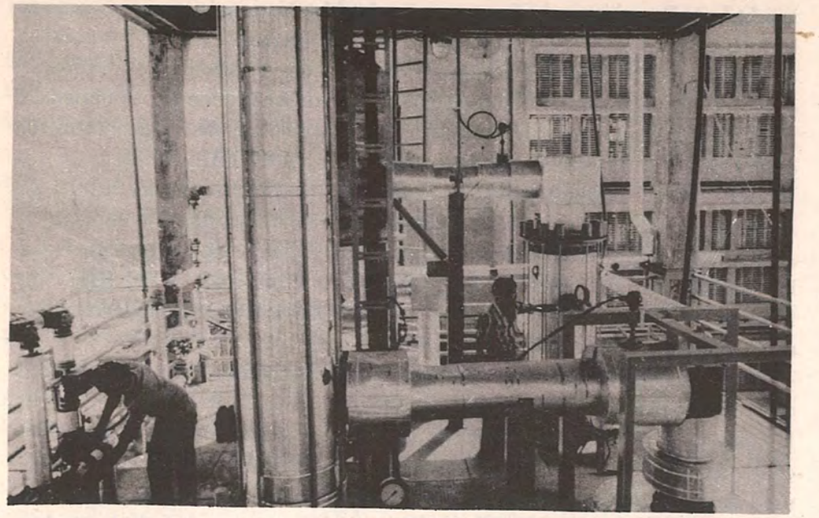
MBC is a broad-spectrum fungicide used in large quantities. M/s J.K. Business Machines Limited have commissioned a plant of 300 TPA capacity at Ankleshwar based on the technology and basic engineering package provided by RRL(H). This is the first plant in India to produce MBC based on indigenous technology. Commercial production is expected to start after satisfactory completion of trial runs.

M/s Shaw Wallace and Company Ltd., Calcutta have commenced commercial production of dimethoate (technical) in their 150 TPA plant at Haldia. Dimethoate belongs to the group of organophosphorus pesticides characterized by low toxicity to man and warm-blooded animals. It is widely used in the control of a wide range of insects and mites on many vegetables, crops, fruits and ornamental plants. M/s Mico Farm Chemicals Ltd., Madras have also recently commenced commercial production of dimethoate (technical) in their 100 TPA plant at Mettur Dam. The annual turnover from these two plants, when fully operational, would be around Rs.2.25 crore. The technology for the production of this pesticide was provided by NCL. M/s Shaw Wallace and Company Ltd., Calcutta have commenced commercial production of ethion in their 100 TPA plant at Haldia. Ethion is an insecticide/acaricide belonging to the organophosphorus group of pesticides and is used for controlling aphids, mites, scales, thrips, leaf hoppers, maggots and foliar feeding larvae on a wide variety of food, fibre and ornamental plants. It is mainly used in tea gardens for control of mites. The annual turnover from this plant when fully operational would be around Rs.90,000 lakh. NCL provided the process technology for this insecticide.

In the silicone project, by a proper choice of experimental conditions, it has been possible to totally suppress the formation of $SiCl_4$, an undesirable byproduct. The problem of recycling has been simplified by an innovative process at NCL. The scale-up unit is being designed and it is expected to be set up in 1983.

The development of catalyst and the associated process for xylene isomerisation and for ethyl benzene was completed by NCL.

M/s Hico Products Ltd., Bombay have commenced production of methylchlorosilanes in their 1000 TPA plant at Kharsundi in Raigad District, Maharashtra, on 26 November 1982. NCL is the first in India to develop an indigenous technology for methylchlorosilanes (in collaboration with M/s Hico Products Ltd., Bombay). This achievement is one of the noteworthy



A view of the reactor section of the 1000 *TPA methylchlorosilanes plant commissioned by M/s Hico Products Ltd., Bombay at Kharsundi in Raigad District*

successes of NCL as a collaborative venture with industry. It is also an example of work initially undertaken out of basic interest resulting in a successful industrial process. At NCL, the process was worked out up to a pilot plant scale of 3-5 kg/hr. The process conditions were standardized and the maximum conceivable design aspects at that stage of work were studied. However, in view of the engineering complexities/difficulties involved in this process, it was felt desirable to perfect the process on a substantially larger scale in collaboration with an industry before it was commercialised. M/s Hico Products showed readiness to associate with NCL on the project. Their association was doubly desirable, since they had been producing silicones with imported chlorosilanes and were earnestly desirous of acquiring self-reliance in respect of production of chlorosilanes.

The basic design of this plant has been prepared by NCL-HICO and the detailed engineering has been carried out by M/s Humphreys and Glasgow, Consultants Pvt. Ltd., Bombay. NCL also has been in close association with HICO during the commercialization of the technology. Organosilicon polymeric compounds, 'Silicones' (for which methylchlorosilanes form basic materials), are industrially very important compounds due to their multifarious applications—more than 20—in industry. The HICO plant, 11th in the world and the first of its kind in India (in fact, in the whole of Asia, except Japan), has been erected at a cost of around Rs.6 crore.

NCL-HICO have decided to offer this technology to any interested entrepreneur through National Research Development Corporation of India.

Punjab Gluconate Ltd., a subsidiary undertaking of the Punjab State Industrial Development Corporation, Chandigarh, have taken up the production of calcium gluconate by submerged fermentation. An agreement has been signed by RRL, Jammu with NRDC, New Delhi. Demonstration and trial runs of the process have been conducted on 500 litre fermenters. Further work is in progress.

A method for regneration of waste moulds into plaster of Paris has been successfully developed at CGCRI. About 1 tonne of regenerated plaster of Paris was sent to two factories for evaluation. The factories reported satisfactory results. The process has now been referred to NRDC for utilization and negotiations are in progress for commercial production.

At the instance of M/s Venkateswara Chemicals, Karur, a process for the oxidation of isoborneol to camphor was developed by CECRI.

Consultancy services were rendered by CECRI on prevention of corrosion of reinforcements in structures, machinery, etc. to M/s Associated Cement Company Ltd., Dwarka.

The process of CECRI for prevention of corrosion of steel reinforcement rods in RCC constructions has been utilized for protecting the RCC in the new 200 metre long Kalwa bridge (Bombay-Pune road) by a licensee, namely, the Executive Engineer, National Highways Division, Thana.

The primer was evaluated under industrial conditions at TISCO Works, Jamshedpur, for a year and a half and the report revealed that its performance is extremely satisfactory under highly corrosive conditions.

An intumescent fire-retardant paint showing considerable promise has been developed at CBRI. Its suitability for application on and protection of materials such as wood and wood products, rubber/plastic covers of cables, metal surfaces, etc. is presently being evaluated before a patent application is made and it is released for commercial exploitation.

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METALS AND METAL FORMING TECHNIQUES

A process has been developed by NML for recovery of tin from tin sludge. An agreement has been made with M/s Tin Plate Co. of India, for treating their tin sludge to produce tin metal. Already tonnage quantities of tin have been produced and supplied to Tin Plate Co.

Scientists of NML participated in the trials for smelting of vanadium-bearing titaniferous ores of Masanikere to produce vanadium-containing pig iron in the 13,200 kVA submerged arc furnace at M/s Visvesvaraya Iron & Steel Ltd. (VISL),Bhadravati. The trials were based on NML technology. M/s VISL will commence commercial production shortly.

NML has developed a hydrometallurgical process for the recovery of vanadium pentoxide from vanadium-enriched slag of M/s VISL and the process is being tested on pilot plant scale.

Know-how developed by NML for the production of distilled zinc dust has been released to M/s Zinc Products & Co. (Pvt.) Ltd., Patna. A consultancy agreement is being negotiated with the firm for equipment selection, plant layout, installation and commissioning.

A soft magnetic alloy based on Fe-Mn-Al composition with a low coercive force, high permeability, high saturation and high resistivity has been developed by NML for use in transformer and relay application. With a view to minimising energy losses in motors and rotating machineries made of high silicon steel, non-oriented low silicon steels are being made and their properties evaluated.

Scaling up of the production of high strength, medium conductivity aluminium alloy conductor, designated NML-PM 215 developed at NML, in the form of wire rod, was successfully carried out at Bharat Aluminium Co., Korba. Manufacture of a prototype 1 km length of catenary wire (19/2.79 mm) from NML-PM 215 for railways has been completed at M/s Indian Cable Co., Jamshedpur as per the Railway Specification. A prototype of multistrand overhead conductor (61/4.25 mm) from NML-PM 215 has also been made for evaluation by the Ministry of Defence. This alloy has potential application for use in coastal area electrification.

To reduce forced outages in thermal power plants, NML has developed wear and abrasion resistant cast iron NML WEARNOT with indigenous materials to be used in components subjected to excessive wear in handling high ash coal and abrasive slurries in power plants.

NML WEARNOT alloy has been industrially processed in collaboration with M/s Mining and Allied Machinery Corporation, Durgapur. Top peripheral liners cast in NML WEARNOT at M/s MAMC were supplied to Chandrapura Thermal Power Station of DVC, and were reported to have given service life of 4000 hours, which is nearly double the life of liners currently being used by this power station.

The use of NML WEARNOT is envisaged for coal pipe bends, impellers

and other components of slurry pumps in association with CTPS (DVC), Central Coal Washeries Organisation (SAIL), Dhanbad and Central Coal Fields Ltd. (Coal India), Ranchi.

CECRI has designed and fabricated a continuous wire plating unit for plating nickel on aluminium wires used in house wiring. This unit is capable of plating wires of diameter 0.3 to 2 mm with a plating speed of 20 to 40 metres per minute, depending on the thickness of the wire and plating conditions. This can be used as a multistrand unit with individual controls in order to attend to failure in any line without affecting other lines.

Extensive laboratory scale studies are underway at RRL (Bhu) to develop hydro and pyrometallurgical routes for winning metals from the ocean nodules. The hydrometallurgical processes are based on (1) ammoniacal leaching, (2) dilute sulphuric acid leaching, and (3) chloride leaching. Each of these routes has shown excellent recovery of metal values (above 90 per cent). The pyrometallurgical processes are based on (1) sulphation, and (2) chlorination of the nodules followed by aqueous leaching. In both the cases, more than 90 per cent extraction of nickel, copper and cobalt and 85 per cent of manganese has been achieved with very little iron contamination. Studies on bacterial leaching have given encouraging results.

A collaborative project between RRL (Bhu) and SAIL on mineralogical characterisation of Barsua iron ore such as banded hematite, Jaspur/quartzite, blue dust, hard laminated and laterite ore sample has been completed and the report has been submitted to the sponsor.

CHEMICAL ENGINEERING, PROCESS DESIGN

The flow improvers SWAT 104 and 106 for transportation of crude oil through pipeline have been tested for restartability at ONGC (BOP), Bombay. SWAT 106 has been found to be comparable to the imported additive shell Swim 5x. SWAT 106 was also tested at TNO Laboratories, the Hague (one of the leading laboratories in the world for taking up rheological studies on petroleum crude) for its activity on Bombay High Crude. It was found to be comparable to all the other pour point depressant additives that are available in the market. Several experiments were conducted on the laboratory restartability unit using Bombay High Crude doped with various additives for a study of their rheological behaviour under different cooling schedules. Hico Products Ltd., Bombay has recently started production of SWAT 104 based on RRL, Jorhat technology.

RRL, Jorhat had entered into an engineering consultancy assignment with M/s Karnataka State Forest Industries Corporation, Bangalore for preparation of a basic design package for 50 TPA plant for production of tartaric acid from tamarind leaves to be set up near Bangalore. The design was based on process know-how developed at RRL, Jorhat. Provision was kept in the basic design to double the production capacity by suitable adjustment of operation and equipment utilizing schedules. Provision was also made in the proposed plant layout for adding a paperboard plant at a later stage.

The process on the extraction of aromatics (benzene, toluene and xylene) from reformed naphthas, developed jointly by IIP and Engineers India Ltd. and offered earlier to Bharat Petroleum Corporation has since been accepted. The first unit based on "IIP-EIL know-how" will have a capacity of 1,75,000 tonnes/annum and will produce about 95,000 tonnes of aromatics against the total production of about 85,000 tonnes from three existing units, which are based on imported know-how. Work on process design has been completed jointly by EIL and IIP. Further process optimisation studies were done with a view to offering the process to units at Cochin Refinery and at Salimpur Aromatics Complex.

For Indian Oil Corporation, studies were completed on bauxite finishing of microcrystalline waxes, including complete process design for industrial unit. The process for the manufacture of 1600 tonnes of microcrystalline waxes per year, conforming to colour and FDA requirements has been released by IIP to Haldia Refinery.

The collaborative research project between M/s Balmer Lawrie and Co. Ltd., Calcutta and CLRI for scaling up of processes developed already at laboratory scale for the production of a range of synthetic fat liquors has reached the final stages. The company has started production in its pilot plant in Madras and is now planning for its commercial scale plant.

A VLE package of great interest to chemical engineers incorporating the

concepts of modularity and routing has been written in FORTRAN language and sold to NOCIL by RRL(H).

Another matrix package incorporating decoupled and coupled approaches has also been perfected and sold to NOCIL. NOCIL has also purchased a general purpose package PROSIM-Business, from RRL(H)

The basic engineering package for a 1000 TPA beta-naphthol plant based on CFRI know-how has been prepared by RRL(H) for M/s Oswali Chemicals, Cuddalore and sent to NRDC which sponsored the project.

With RRL(H) know-how, M/s United Catalysts India Ltd., have started manufacturing catalysts for the conversion of benzene to cyclohexane which will be used by M/s Gujarat State Fertilizer Corporation, Baroda, in their commercial plant replacing the imported catalysts. This catalyst will be sold to other users also.

After completing feasibility studies for the production of metallurgical coke from Bombay High short residue earlier, complete process parameters giving blend composition, operating temperatures, yield and coke quality were studied. The final product was sent by IIP to M/s Graphite India Ltd. and M/s Indian Carbon Ltd., and found suitable by them for metallurgical applications.

A 50 kg/day prototype plant for the production of paperboards from water hyacinth has been set up by the Housing and Building Research Institute, Dakha with technical assistance from RRL(H) and RRL, Jorhat. Training was provided to the Bangladesh scientists and subsequently two scientists from RRL(H) and RRL, Jorhat visited Dakha to supervise and provide the necessary technical assistance during the time of erection.

Desilication of black/green liquor is a chronic problem to the paper industries, particularly to those using silica-rich raw materials. The problem has more bearing in N.E. region, as a good number of paper plants will come up in the region in the near future. The Hindustan Paper Corporation is highly concerned with the problem. A project proposal highlighting the necessity of developing know-how for desilication of black/green liquor in the paper industries, including infrastructural facilities, staff requirement, etc. has been prepared by RRL, Jorhat and submitted to the North Eastern Council for financing the project. The NEC has already conveyed its acceptance of the project and started funding the project.

Process development studies on the production of single cell proteins (SCP) from petroleum molasses and alcohols were continued by IIP in bench/pilot plant scale units, situated at Gujarat Refinery, Vadodara. During this period, 380 kg of SCP sample was prepared from *n*-paraffins for use in long duration chronic toxicological trials at ITRC, Lucknow and field trials on farm animals at Gujarat Agricultural University, Anand.

POST-HARVEST AND OTHER AGRO/BIO-TECHNOLOGIES

Post-harvest Technologies

The fourth energy food plant (12 tonnes per day of 2 shifts) set up by the Karnataka Agro-Corn Products Ltd., with CFTRI technical consultancy, was commissioned at Raichur in September 1982. The other three units located at Mysore, Belgaum and Chitradurga have already been producing this nutritious food supplement for social welfare programmes. About 600 tonnes of energy food were supplied by the Mysore and Chitradurga plants to the Madurai District Pandyan Consumer Cooperative Wholesale Stores Ltd., for the integrated child development programme of Tamil Nadu. CFTRI has been retained as a consultant by this organisation to set up an energy food unit.

CFTRI has provided technical help to M/s Prestige Feed Mills, Indore, in setting up a unit and commissioning the evaporator for manufacturing glucose (600-700 kg/batch) from tapioca. After complete installation of the plant, trial runs were carried out and the factory's technical staff trained.

The CFTRI process for malted beverage with cocoa flavour has been released through NRDC to M/s Mysore Food and Farm Products Ltd., Bangalore. The manufacturing unit (capacity 300 kg/day) installed by the party has been commissioned with the Institute's expertise. The product has entered the Madras market under the brand name "Gokul Malted Beverage".

Under a United Nations University programme, CFTRI has designed a 0.5 tonne/hour capacity plant for dehusking of winged bean and got the prototype fabricated for the Food Research Institute (FRI), Accra, Ghana. A technologist from FRI, Accra has also been trained for 2 months at CFTRI in the erection, operation and maintenance of the plant.

It may be recalled that earlier RRL, Jammu had demonstrated the feasibility of cultivating hops in Jammu and Kashmir on a commercial basis. This has been taken up by the farmers of the state. The laboratory has now executed a turn-key job for hops drying kiln for J & K State Agro Industries Development Corporation, Srinagar. This is an improved one, incorporating a furnace based upon coal firing system. The furnace can also be fired by other agro- or forest wastes to make it independent of power and is provided with automatic temperature and air control systems. The dry hops retain the fragrance and colour to the desired levels because of inbuilt controls. This kiln can handle four tonnes of hops per day to yield one tonne of dried and duly baked hops. It will produce 60 tonnes dry hops costing about Rs 40 lakh during the current season.

Agrotechnologies

A major breakthrough in the isolation of two very high yielding clones of Japanese mint, both in respect of menthol and oil yield has been achieved by CIMAP. These are being tested at two different locations in the country. Such clones, when cultivated on farmers' fields, will give better returns, making the

cultivation of the plant more economical. It is significant that the menthol industry of India has been facing a serious problem of degeneration of parent variety being cultivated at present for menthol. It is expected that the new strains would result in increase in production of oil and menthol by 50 per cent.

Studies on the production of ergot alkaloids by fungi other than *Claviceps* spp. were continued at CIMAP. Further studies on the production of ergot alkaloids by *Aspergillus tamarii* Kita, isolated from seed microflora of *Paspalum scrobiculatum* L. (Kodo), were carried out. The alkaloids produced by the fungus were isolated, purified and characterized. Partially purified toxic substance was tested on experimental animals. The toxin produced typical symptoms of ergot poisoning in animals. The symptoms, however, were more or less identical to Kodo poisoning observed in mammals. Besides *A. tamarii*, three more *Aspergillus* species were isolated from Kodo seeds. All these isolates were also found to produce ergot alkaloids *in vitro*. A crop of Kodo was raised in experimental plots. Investigations on the seed microflora of freshly-harvested seeds showed the absence of association of any toxic fungi. The experiment, thus, revealed that Kodo poisoning is due to the infestation of *Aspergillus* species during storage.

Bio-technologies

Virus-free CO-740 sugarcane plants raised through tissue culture at NCL had been evaluated earlier at the Sugarcane Research Institute, Padegaon and a 20 per cent increased cane yield had been obtained on a 1 acre plot. Planting trials are now being conducted by the Maharashtra State Farming Corporation on a 12 acre plot at Sakarwadi. Field trials are also in progress on NCL tissue culture-raised virus-free Robusta banana plants at the Banana Research Station, Jalgaon and on high yielding cardamom plants at the Indian Cardamom Research Institute, Kailasanadu, Kerala.

E-amino caproyl-sepharose has been synthesized and coupled with Con-A using N-hydroxy succinimide active ester. This preparation of Con-A sepharose of the CSIR Centre for Biochemicals (CFB) has equivalent degree of substitution as compared to that of Pharmacia and Biorad preparations. The enzyme peroxidase which is widely used in Elisa technique can be purified to a high degree using the above affinity media.

Fractionation of immunoglobulins from human serum is carried out using DEA-Guar 5 × 30 prepared by CFB. The results obtained are comparable to those obtained using conventional DE-52 and DEAE sephadex. DEAE and CM-derivatives of guar gel can be used for purification of retinal binding protein from goat serum. The results showed that these derivatives of guar gel give better separation and purification and can be used in place of imported DE-52 and DEAE sephadex.

AGRO/BIO-TECHNOLOGIES

Methods are being standardised by CFB for the isolation and purification of T_4 DNA ligase from *E. coli* (NM 989), Eco-R-I from Ry-13, Hind III from *H. influenzae*, Lambda DNA from RV Lambda C1857, *E. coli* Lambda CI857, RV Lambda CI 857 S7 and Sal-I from *Streptomyces albus*.

Two new high yielding clonal varieties, TV 25 and TV 26, and two high yielding drought resistant seed stocks, TS 463 and TS 464, have been released by TRA to industry. A few more clones from the estate selection scheme are in the pipeline.

ENERGY

Conventional Sources

A 2t/hr steam fluid-bed boiler has been installed in collaboration with BHEL and non-coking coal and washery rejects samples have been tested. A 75 kg/hr pilot plant unit has been designed, fabricated and installed at CFRI for generation of hot air suitable for drying of tea and parboiled paddy. The unit can use coal, waste fuels, paddy husk, etc.

A one-to-one scale model of the fourth stage of an industrial drive turbine being manufactured by Bharat Heavy Electricals Ltd. was fabricated and tested by NAL. Studies carried out under this programme are part of the work proposed to be carried out for generating design data on T-3 profile sections used in various versions of industrial drive turbines.

The 900 tonnes per day low temperature carbonisation plant of M/s Singareni Collieries Company Ltd., Kothagudium, does not now process byproducts. This processing becomes economical at a capacity of 1800 tonnes per day. Complete basic data to design byproduct processing plants have been generated at RRL(H) in collaboration with Engineers India Ltd. (EIL) to enable EIL to design commercial plants.

IIP has continued studies for fuel economy and use of alternative fuels in automotive engines leading to the conservation of petroleum products. Methanol blends were studied in 2-stroke gasoline and diesel engines. A device fabricated to induct methanol up to 35 per cent in a diesel truck was found satisfactory after field trials up to 3500 km. In a two-stroke engine, blends containing 10-15 per cent methanol could be used satisfactorily.

To understand the mechanism of alcohol combustion in automotive engines, basic studies have been taken up. Studies on hot surface induced ignition of pure methanol fuel in diesel engines have been initiated. For fuel economy measurement, the urban driving cycle developed on Delhi traffic pattern was found applicable to different classes of vehicles, viz. cars, scooters, buses, trucks, etc. Further work on an inter-city driving cycle is in progress. Efforts are being made to develop a National Driving Cycle based on this work. Wear and lubrication play an important part in material and energy conservation.

Performance evaluations of 2-stroke engine oils, crankcase engine oils, etc. were carried out to assess lubricating properties and help in developing CSIR-SAIL programme for the development of hot rolling oils for steel industry. Such oils are currently imported. So far, laboratory test techniques have been developed for performance evaluation of 2-stroke engine oils, hypoid rear-axle oils and steel cold rolling oils.

Additional Sources

An integrated system for winter heating and summer cooling of rooms by using rock bed for energy storage has been designed by CBRI. The heating system,

consisting of solar air heaters, rock bed energy storage, and a blower for circulation of air, has been studied for heating a room in winter. A double-walled masonry container fitted with steel grills for supporting pebbles is suitably filled with pebbles of appropriate size to store solar energy for winter heating and the coolness of air at night for summer cooling. Nine solar collectors each of 1 m^2 area fabricated from corrugated and plane galvanized iron sheets have been provided for heating a room of size $3.5 \times 3.0 \times 3.0$ m.

The performance of the system in winter was found to be satisfactory with the room temperature ranging between 18 and 21°C. This system has been commissioned for room cooling during the current summer, for which solar collectors have been disconnected and the coolness of night air is stored in the pebbles for cooling during daytime. In these preliminary experiments, the room temperatures ranged between 27 and 30°C—temperatures within summer comfort range.

The responsibility of lighting the IX ASIAD torch by solar energy was successfully executed by NPL. The Prime Minister, Shrimati Indira Gandhi, lighted the torch with a solar concentrator installed by the laboratory on 19 November 1982 at the National Stadium in New Delhi.

Under sponsorship from the Department of Science and Technology and in collaboration with NBRI, Lucknow, investigations were continued by IIP to obtain hydrocarbons from plants. More than 91 samples of plant species were analysed for percentage content of water, hydrocarbons and total extractives.

The work on the development of ferrocement segmental digester for the biogas plants was completed. Four segments can now be cast over each mould with this method. Three ferrocement gas holders installed in plants at SERC(R) around 1977 were removed from the digesters and critically examined for evaluating (1) the condition of the ferrocement gas holder after remaining submerged in slurry for approximately 5 years, and (2) the condition of the protective coatings applied over these gas holders. No deterioration was observed either in ferrocement or the chlorinated rubber paint applied.

A low air pressure industrial burner has been developed by IIP and licensed to M/s Encon, Faridabad. Field trials were conducted in three large units in the country, and an improvement of 10-25% in fuel efficiency achieved.

RRL(Bhu) has successfully developed a specially designed acoustic burner for combustion of oil-water emulsion on 35 litres/hour capacity saving about 15% of oil.

MACHINERY DEVELOPMENT

CMERI has developed a device for removing vehicles illegally parked at roadside or causing obstruction owing to breakdown, for the Bureau of Police Research and Development, Ministry of Home Affairs, Government of India. The device is simple, economical and easy to operate. It essentially consists of four castor wheels, one channel, four bearings, two shafts and standard fasteners. One extension key and a handle bar are provided to operate this unit manually with very little effort. The vehicle to be removed can be lifted and made to rest on a frame with castor wheels. Thereafter, the vehicle can be towed to a convenient place by a jeep using a two-bar, also designed by CMERI. This will eliminate the use of costly recovery vehicles. A successful demonstration of the unit was arranged at CMERI. Four complete units of the vehicle-removal device along with two extension keys and two handle bars and one two-bar have been sent to the sponsor.

A semi-automatic road-marking machine was designed by CMERI in collaboration with the Central Road Research Institute, New Delhi. It consists of a three-wheeler trolley, a compressor run by a petrol/paraffin engine, one paint spraying nozzle, and other accessories. The trolley is moved manually. With this development, the cost of labour and time involved in marking is greatly reduced. The quality of marking is also improved. The design has been released for commercial exploitation by NRDC.

A combine harvester that can be driven by tractors in the 20-35 hp range has been designed and developed by MERADO, Ludhiana. An auxiliary 20 hp engine is mounted on the combine to power threshing unit, blower cleaning units, grain elevator and the tailings elevator. The combine header can be raised or lowered through a hydraulic cylinder which is operated by the hydraulic pump of the tractor. Manual harvesting of headland has been eliminated. The designed capacity of the combine is 0.44 hectares per hour taking 20 km forward speed/hr and 70 per cent field efficiency. The prototype made has successfully completed its trial in harvesting operation.

MERADO, Pune has developed a test rig for the study of friction and wear characteristics of different materials under varying conditions. The machine is based on pin-on roller principle. An advantage of the machine is that the material can be tested under accelerated wear conditions. The test rig has been installed in the tribology laboratory at CMERI and is working satisfactorily. Attempts at commercialisation of the rig are now being made through NRDC.

CRRI, jointly with CMERI, has developed a gritter for uniformly spreading chips, lime, sand, fly-ash cement, etc. for road construction purposes. The gritter developed is a 2-wheel revolving disc type of about 0.09 cum capacity and is towed manually, by an animal or by tractor.

NAL has entered into an understanding with Defence Electronics Research Laboratory (DLRL), Hyderabad, for the development of metal capsule for electronic equipment pod being developed by them. This development

programme is an extension of the work taken up by NAL on aerodynamics data generation and development of composite radomes.

Under the present programme, NAL is responsible for designing, developing, fabricating, integrating and delivering the metal capsule.

The fabrication and integration of the metal capsule with composite radomes will be subcontracted to HAL. This programme costing about Rs 95 lakh is expected to be completed in two years.

NAL has rendered consultancy service to Vikram Sarabhai Space Centre, Trivandrum on the design, installation and qualification of air heaters for their heat transfer facility. The air heaters are required to heat the high pressure air to temperatures up to 2000°K after which the air will expand through a nozzle to simulate the heat flux encountered in atmospheric flight of launch vehicles.

Two numbers of improved Muga Reeling Machines were fabricated by RRL, Jorhat at the instance of the Regional Silk Research Station (Ministry of Commerce), Titabar, Assam. Detailed engineering drawings and cost estimates were supplied to the party.

A simple device for strip lacquering of end seams of sealed cans to prevent external rusting during storage has been developed by CFTRI. This machine can coat about 1000 A $2\frac{1}{2}$ cans per hour with lacquer (either ordinary golden yellow coloured lacquer or colourless spirit varnish). Blueprints are available from the institute on payment.

The prototype of 37 cm Baruah Continuous Tea Roller for tea processing developed at the Tocklai Experimental Station (TES of TRA) showed good results during the second roll and hence its design has been finalised and given for commercial utilization. Two units earlier manufactured are working satisfactorily. Twenty six units of the larger 45 cm BCR have already been installed in factories.

CIVIL ENGINEERING

At present, top soils are used for manufacture of building bricks. The CBRI process for manufacture of building bricks from plastic black and red soils was adopted at the kilns established by Superthermal Power Project (NTPC), Korba. About 60 lakh bricks have been manufactured during the year 1982-83; bricks using lean red soil and flyash have also been manufactured. The compressive strength of the bricks manufactured is 60-100 kg/cm^2 and the selling price at the site is Rs 200 per thousand bricks.

To minimise wastage of energy in lighting, photocontrols for office buildings and street lights and time delay switches for toilets and staircases, etc. have been designed at CBRI and installed in actual conditions; and their performance has been found satisfactory. The photo-controls for office buildings switch off lights when the illumination on the window pane exceeds 4000 lux and the street light control switches on the lights when the horizontal plane illumination falls to 30 lux. The time delay unit switches off the lights 10 minutes after the lights are switched on.

A comparison of the convectional practice of artificial lighting, task-ambient lighting using table lamps and the recommended supplementary artificial lighting of office buildings was also carried out by CBRI from the viewpoint of initial cost, lamp replacement cost and consumption of energy. It is found that recommended supplementary artificial lighting approach provides the most economical and energy conserving design basis.



A view of the cylindrical unit implanted in a hut (SERC, Madras)

CIVIL ENGINEERING

A sponsored project carried out by SERC(M) for the Department of Light Houses and Light Ships, Ministry of Shipping & Transport, New Delhi, for the development of designs for light beacons, is nearing completion. A 6 m high polymer impregnated, prefabricated concrete structure, to house the light beacon has been erected and tests are in progress to assess the deformational behaviour of the structure under severe coastal conditions.

Another sponsored project from the Directorate of Town and Country Planning, Government of Tamil Nadu, for developing Cyclone Resistant Core Units for huts along the coastal areas of Tamil Nadu, is also nearing completion. Prototype core units have been erected by SERC(M) in four locations along the coast and their performance and user reaction will be studied over a period of 12 months.

SURVEYS & ANALYSES

Encouraged by the results of the survey carried out for polymetallic nodules in 1981, a major programme was drawn up by CSIR and the Department of Ocean Development for detailed surveys for the exploration and mapping of these nodules in the Central Indian Ocean Basin. NIO undertook these detailed studies and besides using the Institute's Research Vessel *Gaveshani*, two more chartered ships, viz. MV *Skandi Surveyor* and MV *Farnella*, have been exclusively utilized for this programme of high priority. Three million sq km of the Indian Ocean were surveyed for locating polymetallic nodules.

The samples of polymetallic nodules obtained from many stations showed encouraging results. These samples have been subjected to analysis for selected elements and also for location of rich areas.

The geochemical analysis of sediments from the western continental shelf between Ratnagiri and Mangalore has been completed and distribution maps for several elements prepared. Similar studies on the eastern continental shelf from Ganges to Calimere point showed highest concentration of manganese (56 to 1162 ppm), followed by nickel, chromium, copper and zinc.

Studies on the dredge samples of the limestone from the continental shelf have indicated the occurrence of phosphorite-bearing limestones at water depths ranging from 80 to 150 m.

Detailed surveys for the heavy mineral placers and their offshore extension were carried out along the 130 km strip of Konkan coast. The onshore sediments of this area contain heavy minerals (up to 91%) and cover an area of 96 km^2. 64% of this is contributed by ilmenite alone.

During the year, Research Vessel *Gaveshani* completed 15 cruises in the seas around India. Out of these, 6 cruises were exclusively devoted to mapping and exploration of polymetallic nodules in the Central Indian Ocean. One of the cruises was for obtaining ground truth data for Bhaskara-II utilization. The ship paid goodwill visits to Maldives and Sri Lanka.

Some of the salient features of the cruises are:

(1) Sampling surveys for polymetallic nodules were carried out at 93 stations through 6 cruises, besides collection of baseline data through echosounding, seismics and magnetics along 31,230 line kilometres.

(2) About 20 stations at 1° intervals were also worked out for the exploration of polymetallic nodules.

(3) During the surveys for the fish spawning grounds in the western Arabian Sea, fish trawling operation was attempted for the first time on-board RV *Gaveshani*.

(4) A cruise for the validation of data derived from Bhaskara-II SAMIR, was carried out during 3-10 June 1982. Data on meteorology, sea surface salinity, wave spectra, etc. were collected.

(5) During the 109th cruise, off Wadge Bank, an interesting feature observed was the presence of step-like thermal structure. This feature indicates alternate mixing zones, probably due to variable wind stress at the surface.

(6) A subtidal reef dominated by spreading type of corals covering an area of 1.5 sq. km off Mormugao Harbour at depth range 6-100 m was discovered.

A joint programme on the utilization of Bhaskara-II SAMIR data was taken up by NIO with the Space Applications Centre (SAC), Ahmedabad. The wind data derived from SAMIR was found to match well with the field observations.

The DSS studies of NGRI along Ujjain-Nepanagar-Mahan showed block structure separated by deep faults. The various crustal blocks identified are: (i) Ujjain-Sanwar block, (ii) Indore-Dorwa block, (iii) Dorwa-Tapti block, and (iv) Tapti-Mahan block. In the shallow section, the presence of Gondwana sediments below the Deccan trap cover is established. Large deposits of coal may be found in these Gondwana sediments.

The basement configuration and the deep crustal structure obtained from DSS studies help in understanding the evolution of the sedimentary basin in Mahanadi delta. The results thus obtained will be utilized for the oil exploration programme of Oil India Ltd.

The DSS studies in the Cuddapah Basin helped in preparing a comprehensive basement picture in and around Cuddapah Basin and on the east coast of India. This has given a new insight in understanding the structure and tectonics of the Cuddapah Basin.

About 28,000 line kilometres of aeromagnetic data were flown in March-April 1982. This included a few East-West tie lines as well as aeromagnetic profiles along the two DSS profiles across the Cuddapah Basin.

Three-component short period seismometers (S-13) and helicorder recorders were installed at a new seismic station in Gauhati (Assam). Similar instruments were also installed at Kaziranga. These two and other five seismic stations at Jorhat, Kohima, Itanagar, Khonsa and Yaongimsen are operating satisfactorily.

Under a consultancy agreement, a comprehensive techno-economic feasibility report for the manufacture of optical components and instruments has been prepared by CSIO and supplied to Kerala State Small Industries Development and Employment Corporation Ltd., Trivandrum. The report contains a brief historical background of optical industry in India. The demand projections and the proposed product-mix have also been highlighted. In addition, the report covers technical feasibility of the project, locational requirements and the proposed lay-out, description of projects's inputs and costs, approximate investment, profitability projections, etc.

RRL, Jorhat has analysed 319 samples received from various outside agencies. Mass spectra were recorded for samples received from the North

Eastern Hill University, Shillong, the Indian Association for the Cultivation of Science, Calcutta, the Indian Institute of Chemical Biology, Calcutta and the Dibrugarh University. Proton NMR spectra were recorded for samples received from the Dibrugarh University, Tocklai Experimental Station, Jorhat and the Bengal Immunity Research Institute, Calcutta. A sensitive method for measuring gaseous hydrocarbon utilizing microorganisms in the soil developed earlier by RRL, Jorhat, was tested in field experiments. Near surface soil samples collected from areas near Jorhat and also from oilfields in Duliajan were examined.

RRL, Jorhat undertook survey work in the Tirap district of Arunachal Pradesh, which is very rich in natural flora and has hitherto remained unexplored. About 170 plant species of importance were collected, most of which were identified and preserved. Apart from this, 448 species of wild higher plant species from the forest of Assam were collected. A total of 151 species comprising 120 genera under 51 families were found to have medicinal properties.

Measures for cathodic protection for steel structures such as Reclamation Berth, Iron Ore Jetty and Sand Pump Trestle were recommended by CECRI to Paradip Port, Orissa, on a consultancy basis.

On completion of a scheme sponsored by M/s Samson Enterprises, Bangalore, studies on rust conversion on partially rusted surfaces were undertaken and a composition based on indigenously available materials for producing a black/grey conversion coating has been developed by CECRI.

At the instance of Fertilizer and Chemicals Ltd., Travancore, studies were completed at CECRI on the corrosion behaviour of CI spun cast pipes of water-cooled sulphuric acid coolers to diagnose the cause of severe corrosion pipes under a simulated condition of acid cooler and it was concluded that increased corrosion was only due to design aspects, because the composition of cast iron tubes of two companies was same.

Ethno-medico-botanical survey of various areas, including Chattarpur, Panna and Rewa (M.P.), U.P. Himalayas, Himachal Pradesh and Kashmir, was carried out by CIMAP and certain well known medicinal plants like Banafsha (*Viola* spp.), Tagar (*Valeriana* spp.), Revandchini (*Rheum* sp.), Jatamansi (*Nardostachys officinalis*) and Thyme (*Thymus serphyllum*) were spotted. Some of the plants, on chemical analysis, have given promising results. Insecticidal activity of *Thalictrum* (Pisumar) and antifungal activity of *Centella asiatica* and *Juglans regia* are being investigated.

In primary biological screening of about 600 synthetic compounds at CDRI, activity was detected in 80 of them. Detailed evaluation of some compounds found active earlier has shown that 80/53 radically cures *P. cynomolgi* infection in monkey, which is an experimental model for relapsing vivax malaria. Another compound (81/470) was effective against natural

infections of hookworm and ascarids in pups and cats. Compound 81/303 showed marked hypotensive response in low dose in rats and cats and was well-absorbed from the gastro-intestinal tract. Promising muscle-relaxant activity has been found in 76/202 and its absorption is better than that of the drug mephenesin. These compounds will now be taken up for pre-clinical development.

Among extracts of 1330 plants screened for various types of biological activity, 14 were found active; follow up studies will be undertaken of 2 plants for anticancer, one for antibacterial/antifungal, one for antifertility, and 12 for pharmacological activities.

The DST-supported Regional Sophisticated Instruments Centre at CDRI carried out spectroscopy (nmr, mass, uv, ir), gas liquid/high pressure liquid chromatography, elemental analysis, electron microscopy, etc. of about 3700 samples for research organizations, universities and industry.

More than 24,000 samples of fruit and vegetable products (majority meant for export) have been analysed by CFTRI under the Fruit Products Order of Government of India. The advice rendered to the manufacturers through the concerned government agencies has helped in restricting the rejection of samples to 2.6% as against 7% in the previous year.

The Central Food Laboratory functioning at CFTRI as appellate laboratory under the Prevention of Food Adulteration (PFA) Act for the states of Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra and Union territories of Pondicherry and Lakshadweep, has analysed 1228 samples of food products received from customs, port health officers and Ministry of Health. In a continued programme of monitoring food contaminants under the FAO-UNEP Indo-Nepal project, 259 samples of food products have been examined for aflatoxin and report furnished to the National Institute of Nutrition—the group coordinator. About 125 samples of food products have also been analysed for lead, cadmium, mercury and arsenic; the levels of these contaminants were within the maximum limits specified under PFA Act.

The 150-year old Governor's residence at Bombay has deteriorated on account of corrosive action of coastal environment. Maharashtra Government had a plan to demolish it on the recommendations of state P.W.D. The problem of making the building structurally safe for habitation was referred to CBRI through the Vice President of CSIR. After careful examination, a proposal for extensive repair was worked out, which would provide a lease of life to the palatial building costing about 10 million rupees, for another 15-20 years at fractional cost only. This will also help retain this historical building with all the old-world charm.

Surveys were conducted by CBRI in two villages, Mewad Kalan (10 km from Roorkee) and Kangri Gram (about 10 km from Hardwar), to assist their development and environmental improvement. The people of village Mewad

Kalan preferred to construct low cost latrines, waste water disposal system, fire-retardant thatch roofs, bio-gas plants and a community centre adopting CBRI's techniques. The techniques were explained to the villagers by personal discussions and demonstration at the site. 12 latrines, 6 soakage systems, 14 bio-gas plants and 3 roofs with fire-retardant technique have been completed. The work on the construction of community centre has started.

Development of computer software for analysis and design of ship structures is a major project sponsored by M/s Hindustan Shipyard Ltd., Visakhapatnam. Programmes for two-dimensional analysis of web frames, shear flow and torsional analysis of thin-walled transverse sections have been developed. A programme for analysis of grillage systems and another on Rule Analysis based on Lloyd's Rules are nearing completion at SERC(M).

CRRI is presently engaged in a major field trial over a length of 20 km to study the technical feasibility of using geotextiles (synthetic fabrics) in the construction of roads on low-bearing soils, especially in the command areas and rural areas. The project has been taken up in collaboration with state governments of Gujarat and Maharashtra and is financed by the World Bank.

A recent survey of the axle-load on National Highways has indicated that the prevailing axle loads are far in excess of the present design axle loading of 8.16 tonnes. The institute has thus recommended the enhancement of design axle-load to 10.2 tonnes. Design curves have been prepared for rigid pavements for the proposed enhanced design axle-loading. Since the heaviest recorded axle-loads during the study were of the order of 20 tonnes, work has also been undertaken to develop design curves for axle-load range of 8-20 tonnes.

Creep evaluation of a number of indigenously produced steels for thermal power plant was continued at NML in collaboration with M/s Bharat Heavy Electricals Ltd. (R&D). Analysis of creep-rupture behaviour up to 30,000 h. as per international practice has been completed on two more grades of steels.

The main object of the failure investigations is not only to study the basic causes responsible for the premature failures but to advise on the remedial measures which could lead to material conservation and smooth/reliable service of technological services, particularly for the public sector. For example, a complete examination of stainless steel wire rope for automatic tensioning of 25 kV over-head catenary line of the Indian Railways was carried out, because the Indian Railways are experiencing frequent failures of stainless steel wire ropes processed from imported wire rod or already drawn wires within a short span of their installation.

The investigation has helped the Research, Design and Standards Organization of the Ministry of Railways to revise the acceptance standards of the material.

Another investigation conducted on behalf of the Railways related to the failure of 25 kV AC Traction Overhead Aluminium Alloy Steady Arm

Components. The correct composition of the alloy for this component and the heat-treatment procedure have been suggested.

NML continues to render service to various thermal power plants by way of:

(i) investigation on the failed components to establish the reason of the failure and the remedial measures,
(ii) estimation of residual life of the high temperature components like boiler tubes, superheater tubes, etc.,
(iii) development of suitable material to withstand heavy erosion due to the corroding nature of ashes.

Physico-chemical assessment of iron ore/sinter from Rourkela Steel Plant has been made by NML on behalf of MECON. Reducibility and low temperature breakdown tests for eight samples of iron ore sinter were conducted on behalf of Indian Iron and Steel Co. Reduction characteristics and low temperature breakdown test of iron ore samples were conducted on behalf of Orissa Sponge Iron Ltd.

Standard samples of sea-bed polymetallic nodules were prepared and supplied to NIO by NML. Standard samples of ferro-vanadium and manganese ore were also prepared and are under certification. 79 kg of different types of standard samples were sold to 230 organizations.

CMRS was concerned with a study relating to controlled blasting for foundation excavation at the Salal hydroelectric project. The object of this study was to establish suitable patterns of drilling and blasting for excavation of rock for foundation of other blocks, so that

(a) the effect of vibration on the stability of adjacent concrete blocks or structures already constructed was within safe limits, and
(b) the rate of production improved.

On the basis of analysis of data, it was concluded that if drilling, charging and blasting were carried out in accordance with the patterns suggested by CMRS, ground vibration could be controlled within safe limits.

The 1.2 m trisonic wind tunnel of NAL continued to provide aerodynamic design data for user organizations as well as for establishing a data base for inhouse R&D work. During the year, a total number of 679 blowdowns were conducted, bringing the overall number of blowdowns conducted so far to 9577. Major test programmes carried out for external agencies include evaluation of separation trajectory of strap-on boosters from the core ASLV vehicle, vital pressure distribution data on canopy of trainer aircraft, detailed wing pressure distribution on a typical fighter, wing force data on PSLV, canard effectiveness studies of a missile under development, etc. Special test rigs have been successfully adapted for these studies.

At the instance of 10 leading manufacturers and users of transformer oil, ERDA is investigating the causes of fast deterioration in the properties of

indigenous transformer oils on storage. Over 30 per cent of the failures of transformers in service are attributed to the deterioration of the transformer oil on storage in transformers. ERDA tested 102 samples of transformer oil, enamelled wires, resins, press-boards, PVC cables, fibreglass tapes, conduit pipes, EC grade aluminium, copper strips, transformers, capacitors, etc. manufactured in the small and medium scale sectors. As a sequel to testing, industrialists in the small scale sector are now seeking ERDA's assistance in improving the quality and reliability of products manufactured by them.

ERDA has completed a project on evaluation of epoxy-8-stage glass cloth, hitherto imported but now manufactured indigenously for application in the insulation systems of rotating electrical machines. This material, manufactured and packed in the 'semicured' stage, has a limited shelf life on storage and has to be cured before that period. Investigations by ERDA have shown that the life can be increased from 18 days to 6 months by storing the material at 5°C, instead of at room temperature.

ECOLOGY AND ENVIRONMENT

With a view to minimising the extent of atmospheric pollution due to emission of sulphurous fumes by foundry/re-rolling mills at Agra and thus protect the beauty and enhance the life of historical and archaeological monuments, NML is experimenting on the following concepts simultaneously:

(i) demonstration of NML designed thermally more efficient cupola for reducing the total amount of pollution through reduction in the coke consumption for the same tonnage production of castings, which also helps in energy conservation.

(ii) a cheaper chemical gas scrubbing system to fix the SO_2 of the cupola effluent gases as solid particulate matter.

(iii) reduction in the amount of SO_2 emissions by incorporating a suitable chemical additive in the coke.

One of the two NML-designed cupolas has already been installed and commissioned. The installation of the other unit is under way. Installation of scrubbing tower is in progress and trials are expected to be carried out soon. The evaluation of existing facilities of solid waste disposal in Delhi and planning the needs for the 21st century has been completed by NEERI. The Report of Phase I has been submitted to Delhi Development Authority, sponsor of the project.

The Third Phase of the research-cum-demonstration project on Slow Sand Filtration was launched in January 1982. Bacteriological studies on water quality have shown that pilot filters with sand depth in the range 27-55 cm have better performance. The virus removal efficiency of filters with sand depths of 24 cm. and above and at filtration rates of 0.1 m/hr. and 0.2 m/hr was found to be quite satisfactory.

Air Quality Monitoring Studies in and around Cochin Port Trust Area have been completed by NEERI. The predominant pollutant is solid particulate matter. The pollution was higher during winter months.

An efficient and economical design of a chimney has been evolved at CBRI for extraction of smoke from kitchens in multistoreyed buildings. It is easy to construct and clean. This chimney ensures total extraction of smoke by avoiding its reverse flow. The system consists of a single common flue to which chimneys from different floors are connected. It is recommended that a separate chimney should be provided for the topmost floor, while chimneys from the rest of the floors be connected to the common flue running along the height of the building and projected about 2 m above the roof. A relationship has also been established between the dimensions of the flue and the number of kitchens to be served. It is reported in a research paper sent for publication.

To support need-based industries and their R&D work and to facilitate product registration by the Central Insecticide Board, 28 pesticides and their formulations were subjected to toxicological evaluation using various species of animals at the Central Facility, ITRC. The plant product karaya gum,

Tylophora alkaloid and samples of mosquito repellents were also evaluated as multicentric projects between ITRC, Lucknow; NIN, Hyderabad; BARC, Bombay and VCRC, Pondicherry.

RRL, Trivandrum has developed a process for prolonging the life of coconut leaf thatch which is used for roofing in more than 60 per cent of houses in rural areas of Kerala. The process consists in dipping the thatch in a solution of copper sulphate and then spraying or brushing with cashewnut shell liquid. It was found that the life of the thatch can be prolonged to more than 3 years and thus the cost of thatching can be reduced to half. The process is being released free of cost for the benefit of rural people.

SCIENCE, TECHNOLOGY & DEVELOPMENT STUDIES

NISTADS continued to cooperate with UNESCO in the "International Comparative Study on the Organization and Performance of Research Units". The institute has been invited by Unesco to write a book on the basis of analysis of data.

NISTADS has also joined the third round of the study for which data on other Indian research institutions and agricultural universities of the Indian Council of Agricultural Research (ICAR) are to be collected. Work is in progress on the preparation of a national addendum and a sampling design.

A comprehensive bibliography is also being prepared; more than 750 references have been collected so far.

On the basis of analysis of data collected from the records of agencies such as ICAR, ICMR and through questionaires filled by recipients of awards, a paper entitled "Dimensions of S&T Prizes: An Appraisal of Indian Reward System" has been prepared.

For the project on "Technological Development in the Small Scale Sector and the Unorganised Sector of Industry through Linkages with the Large Scale Sectors", a preliminary study on concepts and practices, including examples from China, Japan and India, has been completed. A field study at the Bhilai Steel Plant has been completed. Field studies will be continued further.

For the project on "Control of Pest Infestations: Policies for the Pesticide Industry in India", a comprehensive literature survey has been completed. Data on the growth of pesticide industry and production of different types of pesticides during 1970-1980 have been collected. Information on sources of technology, patents filed and technologies utilized by the Indian pesticide industry has been analysed. Two papers, "Structure and Growth of Pesticide Industry in India" and "Analysis of Patents on Synthetic Pesticides in India", have been communicated for publication.

For the project on "Energy Development and Environment—a Study of National Energy Policies in Various Sectors" data have been collected on both renewable and non-renewable sources of energy and energy consumption patterns of major sectors. A comprehensive review paper has been prepared on the above subject.

In the first round survey for identifying the artisan villages, data regarding number of families engaged in various trades and crafts, nature of craft and other demographic details of the artisan families have been collected. Demonstrations have been organized by the scientists of CFTRI, CLRI, CMERI and NML. Problems and their solutions relevant to rural needs, skills and markets have been identified.

A study was undertaken to analyze the extent and character of the interest and interaction of the Indian Parliament and its associated bodies with scientific institutions. The report on "The Role of Parliament in the Formulation of National Science & Technology Policy" has been well received.

A major study on Cultural and Philosophical Roots of Scientific Tradition undertaken on behalf of UNESCO has been well received and commented upon.

For the study on "Science and Technology in Indian Culture", work has been initiated on ancient period at Calcutta, medieval period at Lucknow and study of science under the British period at Delhi. Work is also in progress on various aspects of the development of science and technology since Independence. At the request of the Scientific Advisory Committee to the Cabinet, a report on "25 Years of Scientific Policy Resolution" was completed.

A major study has been launched in collaboration with the West Asia Centre, Aligarh Muslim University on computerized data collection and storage on the development of science and technology in the Arab speaking world.

The Institute continued to publish Current Literature on Science of Science.

A seminar on "Frontier Technologies in the Third World: Towards a Strategy of Self-Reliance" was organized by the Institute at the Indian National Science Academy (INSA), New Delhi during 15-18 December 1982. About 150 participants representing various government scientific departments and agencies, universities and research institutes attended the seminar. The objectives of the seminar were to assess the frontier technologies under consideration, their relevance and significance to the third world countries, the experience of building capabilities in advanced technologies, the routes for acquisition of frontier technologies, the institutional structures and policy measures needed, and the requirements of strategies for technological self-reliance. The seminar was organized in seven sessions and considered 44 papers: 6 on nuclear energy, 12 on microelectronics and information technology, 9 on biotechnology and 2 on general issues.

An international seminar on "The Role of Fundamental Research in Developing Countries" was organized by the Institute at the Indian National Science Academy (INSA), New Delhi during 7-10 February 1983. About 65 national and international participants representing diverse disciplines attended the seminar. The seminar was organized with a view to discussing the issues which impinge upon the promotion of fundamental research and development of science and technology in the developing countries. The main objectives were to explore the desirability or otherwise of the developing countries, undertaking fundamental research and discuss issues such as the policies they should adopt in this regard; direct or indirect benefits which are likely to accrue from it; the institutional arrangements and infrastructure which are required to be developed; and the nature and mechanism of cooperation between developed and the developing countries and among developing countries themselves.

DISSEMINATION OF INFORMATION

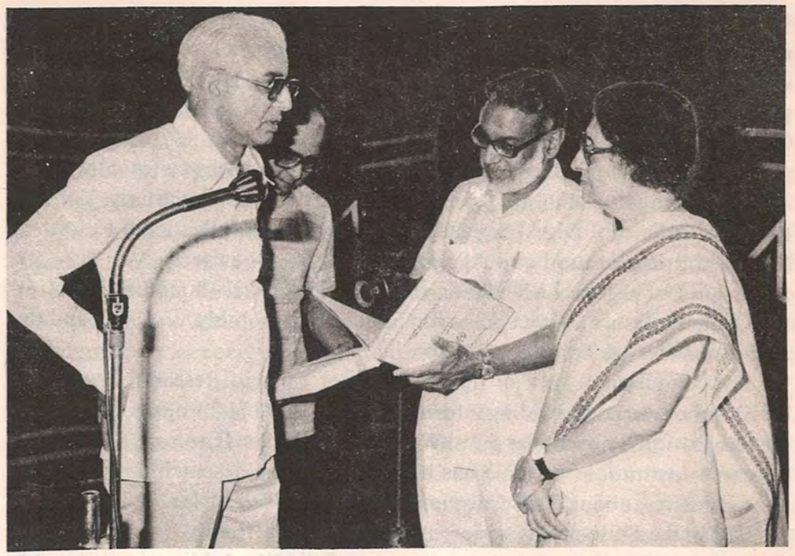
Certain distortions of the contemporary history of science, such as the one projecting science and technology only as a European phenomenon, have been exposed in a recent publication entitled 'Science and Technology in Medieval India: A bibliography of source materials in Sanskrit, Arabic and Persian'. Compiled by Prof. A. Rahman of CSIR (presently the Director of NISTADS) and associates, this bibliography of historical literature and manuscripts on science and technology explodes several myths perpetrated by European scholars. For instance, it is widely known that during the industrial revolution, European scholars not only got access to Arabic, Persian and Sanskrit manuscripts on science and technology, but also translated them into English, and sometimes deplorably, published them under their authorship. Covering literature mostly from the tenth to nineteenth century, the book unfolds the political objectives and intellectual capabilities of the people other than of the European culture areas to serve their aim.

This compilation clearly brings out that throughout the medieval period, the scientific and technological activity was both continuous and vigorous as judged from the number of manuscripts. Though the contributions were principally in astronomy, mathematics and medicine, they did spread over a wide range of other scientific and technological subjects. Treatises of special nature were more in number in contrast to contributions of general nature. Furthermore, the period reveals the preponderance of dictionaries and encyclopaedias.

The publication was released by the Prime Minister, Smt. Indira Gandhi, on 3 June 1982. Complimenting Prof. Rahman and coauthors for their work in bringing together scientific and technological literature at one place to enable scholars to pursue their study, the Prime Minister described the publication as 'a great gift to the country'. Religion, philosophy and science and technology, she emphasized, were part of the Indian culture and scholars should study all the dimensions of our culture.

PID continued to publish the following scientific journals:
Indian Journal of Pure & Applied Physics (monthly, Vol. 20-21); Indian Journal of Radio & Space Physics (bimonthly, Vol. 11-12); Indian Journal of Chemistry—Sections A & B (monthly, Vol. 20-21); Indian Journal of Experimental Biology (monthly, Vol. 20-21); Indian Journal of Biochemistry & Biophysics (bimonthly, Vol. 19-20); Indian Journal of Marine Sciences (quarterly, Vol. 11-12); Journal of Scientific & Industrial Research (monthly, Vol. 41-42); Research and Industry (quarterly, Vol. 26-27); Indian Journal of Technology (monthly, Vol. 20-21); and Indian Journal of Textile Research (quarterly, Vol. 7-8).

The other periodicals that were issued during the period are: CSIR News (semi-monthly, Vol. 32-33), Industrial News Digest (monthly, Vol. 5-6), and Medicinal & Aromatic Plants Abstracts (bimonthly, Vol. 4-5).



Prime Minister Smt Indira Gandhi, releasing the book entitled 'Science and Technology in Mediaeval India: A bibliography of source materials in Sanskrit, Arabic and Persian' compiled by Prof. A. Rahman (Director, NISTADS) (first from the left) and associates

The first volume of the revised series of The Wealth of India: Raw Materials has been sent to press. The seventh volume of Bharat ki Sampada: Prakritic Padarth has also been sent to press.

The research and specimen cell of PID continued to attend to enquiries pertaining to nomenclatural problems. A brief status report on science and technology in India 1982 was also brought out.

The Directorate continued to publish the three popular science magazines one each in English (Science Reporter, monthly, Vol. 20, circulation, about 60,000), Hindi (Vigyan Pragati, monthly, Vol. 32, circulation increased from 52,000 in 1981-82 to 65,000 in 1982-83), and Urdu (Science ki Duniya, quarterly, Vol. 8, circulation 22,000).

Printing and production assistance was rendered by PID in regard to about 15 publications which included annual reports of CEERI, IIP, CSIR, DST and RRL-Jammu's monographs on 'Cultivation and Utilization of Aromatic Plants' and 'Cultivation and Utilization of Medicinal Plants'.

INSDOC and its regional centres in Bangalore, Calcutta and Madras continued to offer documentation and information services in response to specific requests from the scientific community. During the year it handled a

total of 24,387 orders for various services and executed 21,454 orders for document copy supply, 200 orders for bibliography compilation and 1,015 orders (14,677 typed pages) for translation. In all 230,781 pages of photocopies, 78,797 pages of microfilms and 4,146 slides were produced; 26,247 pages were printed.

INSDOC continued to publish the Indian Science Abstracts (monthly, Vol. 17-18), the Annals of Library Science and Documentation (quarterly, Vol. 29), the Russian Science Digest Service in two series, namely National Resources Survey and Exploration and Agricultural Sciences (quarterly, Vol. 1-2), the Accession List of Russian Scientific and Technical Books (bimonthly, Vol. 6), the Contents Lists of Soviet Scientific Periodicals (monthly, Vol. 7-8) and the National Index of Translations (monthly).

The compilation work of the Directory of Current Research Projects in CSIR Laboratories, providing information on about 1714 projects, is over and the publication is now under print. Work of revising the Directory of Scientific Research Institutions in India has been taken up by despatching over 4,000 questionnaires; about 700 institutions have responded so far.

Under the State-of-Art series, a report entitled 'Recent Trends in Wind Energy' was brought out. Another report on Solid Waste Management is also ready and is in print.

In the Union Catalogue programme, a Union List of Current Scientific Serials in India, recording information on about 13,403 serial titles received in 785 libraries was brought out. The National Science Library continued its collection building programme and regular services. It acquired 2,046 documents and received 4,599 current titles of scientific periodicals. The Russian Science Information Centre received 1,620 and 230 Russian books and journals respectively from VINITI, Moscow.

The National Information Centre for Drugs and Pharmaceuticals, sponsored by DST and CDRI, published the monthly bulletins: Current Highlights (R&D), Industry Highlights, Patent Awareness and Current Indian Titles. An 'Annotated Bibliography of Publications on Medicinal Plants from Central Drug Research Institute, Lucknow, 1951-1981', published in Drugs & Pharmaceuticals: Current Highlights (R&D), Vol. 5 (Supplement), 1982, pp. 135, was released on the occasion of a UNESCO sponsored Regional Workshop on 'Use of Pharmacological Techniques for Evaluation of Natural Products' organized at CDRI during 18-27 October 1982. The national information centres for leather at CLRI and food technology at CFTRI continued to provide bibliographic and documentation services to the users.

CFRI has published 'Indian Coals, Vol. 8' on tertiary coal and lignite deposits of India. With this publication, the series of monographs on 'Indian Coals' has concluded.

INTERNATIONAL SYMPOSIA

An International Conference on Water Hyacinth (*Eichhornia crassipes*) was held during 7-11 February 1983 at RRL, Hyderabad. The Conference was jointly sponsored by the Commonwealth Science Council, London, Council of Scientific & Industrial Research, India, United Nations Environment Programme, Nairobi, the Department of Science & Technology, Government of India and the United Nations Financing Systems for Science and Technology through the Regional Centre for Technology Transfer, Bangalore. The Conference was attended by 50 foreign delegates from 22 countries and 79 Indian delegates. Six plenary lectures were delivered by eminent scientists of international repute working on water hyacinth and the technical discussions were spread over 13 scientific sessions. In addition, there was also a session on International Cooperation. More than 70 papers were presented during these sessions.

A Joint INDO-US Workshop on Global Ozone Problem was held at NPL, New Delhi, during 11-20 January 1983. The Workshop was organised on the recommendation of the Joint INDO-US Commission on Scientific Collaboration with Dr. A.P. Mitra, Director, NPL as the Chairman of the Organizing Committee. Twelve leading scientists from the USA and more than 50 from within the country participated.

A Regional Working Group Meeting of Metrology for South and Central Asia was organized at NPL during 9-11 August 1982 under the joint auspices of Unesco and NPL. It was inaugurated by Prof. S. Nurul Hasan, Vice President, CSIR. Participants from Afghanistan, India, Maldives, Nepal, Pakistan and Sri Lanka presented their country reports followed by discussions and technical sessions. The meeting came out with a nine-point recommendation-cum-action plan on the basis of five technical sessions.

NEERI organized a four-day Regional Workshop on "Rural Water Supply" during 10-14 May 1982 at Madras.

The Commonwealth Science Council, London was the sponsor. Participating countries included India, Bangladesh, Sri Lanka, Papua New Guinea and Seychelles.

A Commonwealth Regional Workshop on Transfer of Technology to Rural Areas was organized by CBRI at Roorkee druing 2-4 February 1983. Eleven foreign delegates from Sri Lanka, Papua New Guinea and Bangladesh participated in it. The workshop ended with a set of recommendations for adoption at the national and regional levels.

A Workshop on "Radio Propagation in the Tropics" was directed by Dr. A.P. Mitra, Director, NPL who is also the Chairman of the URSI Committee on Developing Countries. The Workshop was organized by the International Centre for Theoretical Physics, Trieste, Italy, during November 1982. About 72 scientists from developing countries of Latin America, Europe, Africa, Middle East, South East Asia and Asia, including China, participated. Dr. B.M. Reddy of NPL also was a member of the Faculty.

TRAINING COURSES

A six week training course sponsored by UNESCO and CSIR on "Methods and Techniques in Exploration Geophysics" was organized by NGRI. Representatives from four developing countries—Nepal, Iran, Sri Lanka and Jamaica—participated.

NIO organized an International Training Programme on 'Marine Resources Management and Conservation in the Indian Ocean Basin and Adjacent Seas' during 4 October-10 December 1982, in collaboration with International Ocean Institute (IOI), Malta. This programme was co-sponsored by the Ministry of External Affairs and the Department of Ocean Development of the Government of India, Commonwealth Secretariat, CIDA & FAO, UNEP and other UN Agencies.

Scientists from Iran, Sudan, Iraq, Thailand, Sri Lanka, Philippines, Vietnam and India participated. Lectures were delivered by eminent Indian and foreign scientists. Field trips were also undertaken to various related institutes in Bangalore, Cochin, Trivandrum and Bombay in India, Male in Maldives and Colombo in Sri Lanka.

A training course on Repair, Maintenance and Handling of Analytical Instruments sponsored by FAO, Rome was organized by CSIO, during 17 November - 11 December 1982 for 12 participants drawn from 12 countries, namely, Camaroon, Chile, Cuba, Ecuador, Fiji, Granada, Guyana, Malaysia, Mexico, Sri Lanka, Venezuela and Vietnam. The course was followed by a 3-day terminal workshop in which the participants interacted with the CSIO and CFTRI faculty members and experts from FAO, UNEP and the Ministry of Health, Government of India.

The Indo-Swiss Training Centre of CSIO continued to conduct its three-year Diploma Course in Instrument Technology and one-year Post-Diploma Course in Industrial Electronics and Die and Mould Making. This year, 93 trainees successfully completed these courses. They included 65 in Diploma in Instrument Technology, 12 in Post-Diploma in Industrial Electronics and 16 in Post-Diploma in Die and Mould Making.

The fourth international course on "Control of Environmental Contaminants in Food" sponsored by FAO-UNEP was held during 20 September - 15 November 1982. The courses had 12 participants representing Cameroon, Chile, Cuba, Ecuador, Fiji, Granada, Guyana, Malaysia, Mexico, Pakistan, Sri Lanka, Venezuela and Vietnam. The expertise of CFTRI has also been utilized in training a total of 61 persons in 3 short-term courses, in the areas of fruit and vegetable technology, production and analysis of alcoholic beverages and biscuit manufacture. These were in addition to the 1980-82 post-graduate course run by the CFTRI where 19 participants from developing countries received the M.Sc. degree of Mysore University. The International School of Milling Technology functioning at CFTRI has trained in its first 10 month course, 12 participants from Indian roller flour milling and allied

industries in the areas of flour milling technology. In-plant and on-the-floor training is an essential feature of this programme.

An orientation-cum-refresher course for the officers of extension centres of National Buildings Organisation and the Central Building Research Institute was organized at CBRI, Roorkee, during 6-9 October 1982.

CRRI held refresher/training courses in which nearly 150 nominees of various highway engineering departments such as the central and state P.W.D.'s, Engineer-in-Chief's Branch of the Ministry of Shipping and Transport, Municipal Corporations, Town Planning Organisations and traffic authorities of different states participated.

A special training course on "Pollution Control", with special reference to refineries, was conducted by NEERI on behalf of Indian Oil Corporation during 14-24 December 1982 for 15 IOC personnel. A course manual on Air and Water Pollution Control was brought out on the occasion.

Three advanced courses on "Experimental Stress Analysis—Techniques and Applications", "Design and Construction of Prestressed Concrete Structures" and "Limit State Design of Reinforced Concrete Structures" were conducted by SERC(M) during the year for the benefit of practising engineers in the country.

Six participants from Sri Lanka, Malaysia and Bangladesh along with two participants from CMERI participated in a two-week specialized training programme on design, development and testing of diesel engines held at CMERI during 23 November - 6 December 1982.

INSDOC continued its regular training programme in Information Science. The 18th session of the course terminated with 15 students and the 19th session started with 14 students.

A course on Materials Management in R&D was held at CFTRI, Mysore, during 26 April - 6 May 1982, in which 36 stores and purchase officers drawn from 27 CSIR laboratories, Defence Research & Development Organisation, Indian School of Mines (Dhanbad), Space Applications Centre (Ahmedabad), National Institute of Virology (Pune), and Botanical Survey of India (Calcutta) participated. The faculty was drawn from the CSIR's Centre for Management Development in R&D (NISTADS), Administrative Staff College of India (Hyderabad), Indian Institute of Management (Bangalore), Army Headquarters, and the Directorate General of Supplies and Disposals.

Three short-term training courses of 3 months' duration each, on 'Petroleum Refining Technology' were conducted by IIP. These courses were run for 109 freshly recruited chemical engineers of Indian Oil Corporation, Bharat Petroleum Corporation, Hindustan Petroleum Corporation and Assam Oil Division of IOC.

OTHER ACTIVITIES

CSIO continued to extend repair and maintenance service of scientific and industrial instruments through its network of nine Service and Maintenance Centres in the country. This year, the Centres repaired about 1953 instruments valued at approximately Rs.223 lakh.

Metals such as aluminium, magnesium, zirconium etc. are used in ordnance manufacture and in the paint industry. Fires in these cannot be extinguished with ordinary extinguishing agents. A dry metal powder specially suited for extinguishing fires in powders of metals such as these has been developed at CBRI and has been found to be better than one developed elsewhere in India and being manufactured currently.

The Regional Research Laboratory has started functioning in Madhya Pradesh at Bhopal. Substantial work on synthesising aluminium ceramic particle composites from mineral resources of M.P., and characterizing their properties has been completed. Techniques to deposit several types of films on the surfaces of these composites have been developed. Physical and mechanical properties of certain natural fibres like sunhemp, sisal, kushagrass and banana fibre available in M.P. have been determined and they formed into composites with polymers.

A one-day NCL-ICMA get-together was held at NCL on 8 October 1982. Organized jointly by NCL and the Indian Chemical Manufacturers' Association (ICMA), Bombay, the get-together was attended by more than 200 participants, including executives and R&D and production managers. The representatives of the industry availed themselves of the opportunity to get to know NCL's R&D programmes and facilities available to tackle problems of the large, medium and small scale sectors of the chemical industry.

The Sixth National Symposium on "Recent advances in catalysis and catalytic reaction engineering" was held at NCL during 5-7 February 1983. The symposium was jointly organized by NCL and the Catalysis Society of India, Madras. The symposium was attended by about 200 Indian and foreign delegates.

An FICCI-CSIR Scientists get-together on pesticides, presided over by DGSIR, was organized on 17 November 1982 to exchange views on the R&D projects on pesticides undertaken in the various national laboratories. More than 40 representatives from FICCI attended the meeting at RRL(H). The meeting came out with specific recommendations in the field of R&D on pesticides.

BASIC RESEARCH

Physics (NPL)

Anomalous behaviour of Chevral phase superconductors explained

For the last few years, anomalous behaviour of Chevral phase superconductors of molybdenum sulphide and selenide containing a rare earth element like Eu has remained a completely unresolved frontier problem. Particularly, although both $EuMo_6S$ and $EuMo_6Se_8$ seem in every way identical materials, the former exhibits a negative dR/dT at 110 K and superconductivity under pressure, while the latter shows a rapid drop in resistance at 110 K and never becomes superconducting under any pressures studied. For the first time ever at NPL the problem has been tackled using ESR technique on a series of above materials. The results show that the whole dilemma is due to different coupling of Eu^{2+} ions with conduction band in the two systems. In $EuMo_6S_8$, the exchange coupling is negative, while it is positive in $EuMo_6Se_8$, which explains the resistivity dilemma in terms of Kondo and itinerant electron ferromagnetic coupling respectively. This work, apart from its obvious significance, goes a long way in giving a further strong credence to the new superconductivity model given by the NPL scientists, and reported earlier (1980-81).

Josephson tunnelling and non-equilibrium superconductivity

A new type of current-voltage characteristic has been observed in solder blob type Josephson junctions. In addition to the usual zero voltage region, a low-differential-resistance region just above the zero voltage critical current has been observed for the first time in this configuration. This region is found to behave like a voltage dependent pair current and is explained in terms of the stimulation of supercurrents in the weak link. The superconducting value of the low-differential-resistance region is confirmed by the observation of a systematic variation of its amplitude with microwave power and also the display of constant voltage steps due to the AC Josephson effect in the I-V curves. A detailed study of hysteresis between the low differential-resistance region and the normal region also confirms the superconducting nature of the low-differential-resistance region.

Lead monoxide—A promising photoconducting material

Studies on the effect of heat treatment on photoconductivity and electrophotographic properties of lead monoxide have been conducted and it has been found that there is a critical temperature of annealing for lead monoxide at which its photo-sensitivity is maximum and the dark conductivity minimum. Further, its acceptance potential, dark discharge rate, contrast potential, etc., improve considerably on thermal treatment.

Studies on the mechanism of electrical conduction in polymers

The mechanism of electrical conduction in polymers in their pure and iodine doped forms has been investigated at NPL. In polyvinyl fluoride (PVF), the electrical parameters such as average drift mobility, trapped carrier density, activation energy, etc., have been found to depend strongly on the concentration of iodine. The results have been explained on the basis of the formation of charge transfer complexes.

The electrical conduction in solution-grown polycarbonate films has also been investigated. The Richardson-Schottky Effect has been suggested as the dominant mode of conduction at moderate fields, whereas at high fields the current has been found to be space-charge limited..

Studies on absorption isotherms

Theoretical work on vapour absorption on porous materials by means of a new absorption isotherm equation has been done for obtaining the different parameters such as mesopore area, degree of microporosity, surface area, limiting micropore area, and monolayer capacity, etc. The isotherm equation has been extended successfully to binary and tertiary isotherms. The equation is useful in characterizing the structure of porous materials.

Geophysics (NGRI)

The programme of seismic surveillance has been continued and the stations already installed have been operated satisfactorily. The seismograms from these stations were routinely analysed and preliminary seismic phase data have been prepared for the earthquake events occurring during the period January to April 1982. The network of seismic surveillance stations recorded nearly 1200 earthquakes during these four months. At least 270 earthquakes were recorded from the North-Eastern region. The establishment of the new stations at Itanagar (Arunachal Pradesh) and Kaziranga (Assam) has enhanced the study to a large extent. One 3-component seismic surveillance station has been established at Gauhati. The station is equipped with S-13 seismometers, analog amplifier, ink writing helicorder amplifier of model AR-320 and helicorder of model RV-301B. Reconnaissance study was made at Bomdila (Arunachal Pradesh) and Haflong (Assam) for establishment of two more seismic surveillance stations.

Homogenisation of eqrthquake magnitudes

Significant differences in magnitudes of some earthquakes are often reported by individual seismic stations and by agencies collecting seismological data from a number of stations. These differences lead to undesirable uncertainties in seismology, seismic hazards mitigation, building construction codes and earthquake prediction studies. To optimise the differences in magnitudes, a

study on homogenisation of earthquake magnitudes based on the vertical component short period P wave data has been carried out. An empirical amplitude-distances curve has been derived for the vertical component short period P wave of nuclear explosions at teleseismic distance.

Geochemistry

The studies have shown that after initial differentiation of the earth, the process of '*sima-sial*' transformation has been governed mainly by exogenic processes. Through the available data it was visualised that soon after the primary degasing of the earth, the global simatic crust was covered by a thin hydrosphere. The transition zone between Archaean low- and high grade rocks in southern India which consists chiefly of tonalite-trondhjemite genesis and shows incipient charnockitization appears to have been derived from tonalite protoliths. Based on the geochemical studies on the transition zone, it was inferred that relatively high heat-flow and large characteristic depth for radiogenic heat-producing elements are consistent with undepleted crust at 25-35 km beneath most of India.

A UNDP project on 'Techniques for Mineral Exploration' has led (among other things) to development of an effective technique for geophysical measurements and interpretation useful in mineral exploration. A micro-processor based EM induction prospecting unit has been developed. One of the outstanding spin-offs from the project is the development of a 'Fast Computer Software' for application in the mineral exploration and for computing the response of underground targets of any shape under electromagnetic excitation. Using the integral equation approach and applying the digital linear filter, the project scientists have achieved a speed of computation that surpasses that of all the other previous known techniques.

Geodynamic Studies (RRL Jorhat)

Research activity conducted on the geodynamic and related studies along the Indo-Burman suture zone established the occurrence of typical ophiolitic rock types. Furthermore, the identification of radiolarian fossils in the charts of the flysch ophiolite complex threw light on the probable age of the Disang series and the foundation period of orogen.

Oceanography (NIO)

Studies on the quality of water based on the presence of pathogenic forms such as *Vibrio*, Salmonella coliforms, etc. were carried out both in overlying waters and the sediments off the mouths of the rivers Krishna, Godavari, Mahanadi, Hooghly and the New Moore Island. Sediments at all stations harboured more population than the overlying waters. One of the significant findings during the study was the occurrence of *Vibrio parahaemolyticus*-like organisms (the etiologic agent in food-borne gastroenteritis) both in water and sediments.

The distribution of meiofauna in the Central Indian Ocean basins exhibited a negative trend with increasing depth, but a positive trend with distance from shore.

The technique of thin layer chromatography (TLC) for the separation, identification and quantification of organic acids in the extracellular exudate of phytoplankton was standardized. The analysis of water samples collected during 91 and 105 cruises indicated the presence of a second organic acid, besides glycellic acid. The second unidentified acid was found to change with depth of water and intensity of light.

Aquaculture

Under the aquaculture programme, a survey for the seed resources of Prawn, *Penacus indicus*, was initiated at Cochin besides its monoculture and the culture of *Etroplus suratensis*. In one of the trials of field culture of *E. suratensis*, about 20,000 fingerlings were collected in two days which could fetch about Rs.200. Popularization of aquaculture through field demonstration was also started.

A survey for the Artemia resources was undertaken along the Andhra coast. The area between Masulipatnam and Kakinada has been found to be suitable for the culture of the brine shrimps and accordingly people in the area have been convinced about taking up such job to earn additional income.

Biological aspects

Studies on seasonal changes in organic production in relation to the limiting activity of nutrients indicate that nitrate is often in short supply. In the water of Goa, this was, however, compensated by the regenerated NH_3-nitrogen. Studies have indicated that though phytoplankton is a major source of particulate matter, large fraction of these could have been derived from the river-born detritus.

Pathobiological studies on the grey mullets showed them to be heavily infected by an ectoparasite, *Caligus bombayensis*, which results either in the deterioration of the prime quality of fish or total mortality. A dip in 0.02% formaldehyde has been found to be very effective in eradicating the infection.

Based on comprehensive analysis of IIOE data along six meridional sections covering the entire south Indian Ocean, charts have been prepared showing temperature, salinity, density and the field of motion along the horizontal and on a few selected isopycnal surfaces.

Arrays of rotor current meters and wave rider buoys were installed off Daman and Umbergaon for continuous recording of current and wave data during the southwest monsoon. The average speed of the current during the spring and neap tides was 1.0 and 0.50 m/sec respectively. The maximum wave height noted during the Gujarat cyclone (November 1982) was 8.4 m.

Chemical aspects of oceanography

Detailed chemical investigations on methyl coral *Porites lutea*, which exhibited antifertility activity, led to the characterization of *n*-octadecyl alcohol, the corresponding acid and its methyl ester. Besides this, new extracts from 11 marine organisms have been obtained which have shown pharmaceutical activity.

Chemical analysis of water samples from depths up to 4 km of Central Arabian Sea revealed the occurrence of two oxygen minima. The water samples from the Wadge Bank area showed boron concentration between 3.90 and 4.95 mg/kg.

Chemistry (NCL)

Carbonyl complexes and clusters of ruthenium and rhodium

Studies on ruthenium carbonyl cluster, triruthenium dodecacarbonyl, $Ru_3(CO)_{12}$ supported on aerogel-200 zeolite (SL-153), γ-alumina, magnesium oxide, titanium dioxide, and zirconium dioxide have been carried out. Several bimetallic carbonyl clusters containing Ru and Fe have been prepared.

A series of six coordinated complexes of Ru(II) of the type $Ru(CO)_2$ (bipy or 1,10-phenan) L_2, where HL is a bidentate chelating ligand has been prepared. Several chelated ruthenium and rhodium carbonyl complexes containing chelating ligands and phenyl phosphines have been prepared and investigated. These new complexes are expected to show activity as homogeneous catalysts in the syntheses involving carbon monoxide.

Cyclopropane derivatives as miticides

Twenty five esters incorporating cyclopropane ring were tested against pink mites and purple mites occurring in tea plantations. Some of the compounds have been found to be superior to the products which are being used at present.

Synthesis of new pyrethroids

t-Butyl-IR-*cis*-2,2-dimethyl-3-acetoxymethylcyclopropane carboxylate, an intermediate for the synthesis of some pyrethroids, has been prepared from 3-carene.

Two new pyrethroids, viz. 3-phenoxybenzyl-IR-*cis*-2,2-dimethyl-1-3(2-*p*-chlorophenylprop-1-enyl) cyclopropane carboxylate and 3-phenoxybenzyl-IR-*cis*-2,2-dimethyl-1-3-(2-cyclohexylprop-1-enyl) cyclopropane carboxylate have been synthesised.

Synthesis of homobrassinolide

The plant growth promoters homobrassinolide, homocastasterone, deoxyhomobrassinolide and deoxyhomocastasterone have been synthesised starting from the phytosterols present in sugarcane press mud.

Pheromones
A novel synthesis of 2,6-dimethyl-1-6-heptadien-3-yl acetate which is known to mimic the activity of comstock mealybug is one of the pests of apple, pear and other agricultural crops.

Synthesis of a new perfumery chemical
Acetylaloisolongifolene, a new perfumery chemical having a rich woody amber fragrance has been prepared on laboratory scale.

Synthesis of tetrahydro-anthrapyridine derivatives
Leuco-aminoanthraquinones have been found to condense with some α,β-unsaturated carbonyl compounds to give tetrahydro-anthrapyridine derivatives which may possibly have therapeutic value.

Studies on the anions of o-hydroxyarylamides
It has been shown that saturation transfer may be successfully employed for studying the nature of the anions of *o*-hydroxyarylamides.

Synthesis of isocyanate terminated polybutadienes
A novel approach for the synthesis of isocyanate terminated polybutadienes has been worked out by using a new azobisnitrile type initiator for the first time. This initiator could also be used for the preparation of isocyanate terminated polymers from dienic and vinyl monomers.

New organic disulphides and their derivatives
A new class of organic disulphides have been synthesized by reacting sulphur monochloride with organic bidentate ligands, like salicylaldehyde, B-diketones and hydroxy-ketones, X-ray crystal structure of dibenzoyl disulphide shows that the phenyl groups are *trans* with respect to S-S linkage and the dihedral angle is 66°. The bissalicylaldehyde disulphide gives an axine derivative when reacted with salicylaldehyde hydrazone or 2-hydroxyacetophenone hydrazone. Several new coordination compounds of these ligands with chelated titanium or organotin moieties have been prepared and studied.

Ferrocenylidene derivatives and heterometallic cluster compounds
By condensing acetyl ferrocene and/or formylferrocene with aroyl hydrazines, several ferrocenylidene derivatives have been isolated and some bimetallic complexes of these ligands have been prepared and characterized. Some of these complexes may find use as precursors for preparation of selective catalysts.

RRL, Jammu
A novel method of ring opening of coumarin using potassium hydroxide in DMSO has been developed. This method was successfully used for the facile

synthesis of Furopinnarin. The highlight of the synthesis involves ring opening of Bergaptan in the presence of prenyl bromide resulting in the formation of *cis*-cinnamate derivative in quantitative yield. This was subjected to Claisen rearrangement to yield the title compound in 80 per cent yield.

A series of compounds derived from 2-mercaptobenzimidazoles possessing significant and sustained hypotensive action have been synthesised.

Piper clusii has been found as a new source for the possible anti-cancer ligans in high yields besides yielding two new lignans, (-)-2-furanol-4(1)3-benzodioxol-5-yl methyl tetrahydro-3(3,4,5-trimethoxy phenyl) methyl and its dihydro derivative.

Two novel iridoid glucosides identified as 6′-*p*-hydroxylbenzoyl mussaenosidic acid and 2′-*p*-hydroxybenzoyl mussaenosidic acid have been isolated from *Vitex negundo*.

Natural products and synthetic organic chemistry (IICB)
Bharatamine, a protoberberine alkaloid which, contrary to the established biogenetic route to these bases, must be of monoterpenoid origin, has been isolated from the seeds of *Alangium lamarckii*. Its structure has been elucidated and established by synthesis. A few more natural products of biogenetic interest, like the demethyl protoemetinols from the same plant and new 4,5-dioxoaporphine from *Aristolochia indica* have been isolated and characterised. Vincatine, a *Vinca* alkaloid, has been synthesised to establish its structure and stereochemistry.

The isolation of a novel - skeleton macrocyclic spermidine alkaloid, $C_{25}H_{31}O_3N_3$ from *Caesalpinia digyna* Rottl., a medicinal herb reputed for its use in phthisis and diabetes, has been achieved. The structure of the novel alkaloid was determined by a combination of chemical and spectrometric methods as well as single crystal X-ray analysis. The compound which has been designated as caesalpinine-A possesses a 13-membered lactam ring fused to a 5-membered lactam ring. It also contains two monosubstituted benzene rings. The biogenetic pathways of formation of the new skeleton have also been suggested.

The studies on elucidation of the mode of action of sanguinarine, a benzophenanthridine alkaloid, at the molecular level, revealed for the first time that (a) sanguinarine shows very interesting characteristics from the standpoint of its absorption and fluorescence spectra under various *p*H values, (b) it binds to DNA by monofunctional mode of intercalation, and (c) it has preference for G-C base pairs in DNA.

CSMCRI
In regard to fractional crystallisation of sub-soil brine it was observed that high magnesium content slows down the evaporation of brine and saturation point

was shifted from 25.6° Be to 25°Be. Further, separation of $CaSO_4$ was almost double that of sea brine and is continued with salt crystallisation.

A series of porous polymeric adsorbents based on styrene-divinyl benzene matrix having range of porosity and degree of crosslinking were synthesised. They contained thiol group as the complex forming entity and showed enhanced uptake of mercury, in the range 4.5-7.8 meq. of Hg per g of the adsorbent.

A good number of anion exchangers were prepared by halogenation of 2 per cent crosslinked styrene divinyl benzene matrix. On characterising for wet absolute density and ion-exchange capacity many of these have shown promise for applied trials.

In the studies on photochemistry of coordination compounds and solar photo-electrochemical conversion, colloidal cadmium selenide was prepared and successfully used for producing hydrogen through photoelectrolysis.

Mass transfer studies in loop reactor (RRL, Jorhat)

A loop reactor assembly consisting of a glass holding vessel, a circulation pump and a nozzle for generating a high gas-liquid interface was installed. Mass transfer studies were in progress to estimate interfacial area and mass transfer coefficient for air-water system. The studies were done in collaboration with the Chemical Engineering Department of UDCT, Bombay.

A spouted bed contactor consisting of a 3″ dia glass column and gas supply and metering system was fabricated and installed for studying the spouting characteristics of Assam coal. Preliminary studies were in progress to evaluate effective bed height, minimum spouting velocity and pressure drop.

Crystal structure solution by X-ray single crystal diffraction technique

Crystal structures of 5-bromo-3 phenyl-2,1-benzisoxazole and 5-chloro-3-phenyl-2,1-benzisoxazole were solved partially.

2,1-*Benzisoxazoles*

The chemistry of 2,1-benzisoxazoles was systematically investigated and revealed several interesting features, e.g. a novel reaction with thionyl chloride giving an easy method to prepare *o*-aminobenzophenones. Benzophenones are crucial intermediates in the synthesis of benzoidazepine group of drugs. Interestingly, the 2,1-benzisoxazoles under reference showed aromatic as well as orthoquinonid characters.

Benzofurazan oxides

Organic N-oxides provide an important area of biologically active compounds. Though some of the organic N-oxides have shown good biological activity, they are not used for human consumption but are used as

animal feed. Reaction of benzofurazan oxides (BFO) with conjugated enamines resulted in new organic N-oxides which aroused considerable interest in comparison to well known Beirut Reaction. Keeping this in view, BFO chemistry was investigated and good results were emerging giving novel organic N-oxides.

Oils and Fats (RRL, Hyderabad)

Variations in oil and protein contents and in the composition of fatty acids and amino acids which can affect the yield and the quality of the products derived from castor seed have been investigated in 19 varieties of castor seed.

Growth-related changes in fatty acids of plant tissues were carried out on four malvaceal plants producing cyclopropane fatty acids. Notable changes were observed in the fatty acid compositions of various tissues at the time of the flowering of the plants. Fatty acids and amino acid compositions of various tissues at the time of the flowering of the plants were studied. Fatty acids and amino acid compositions of 80 newer oilseeds were determined in the course of the survey of new resources of oil and protein.

Lipid class and fatty acid composition of leaf lipids of some selected plants including water hyacinth were determined as a part of the survey for newer sources of hydrocarbons and waxes.

Photochemistry (RRL, Hyderabad)

Structure-reactivity and molecular dynamic studies in organic synthesis

The results obtained from the studies carried out on the diene reactivity of 1-methyl-2(H)- pyridine (MP) in 4 + 2 cycloaddition reactions with 3-substituted propyne nitrile have shown that the aromatic lactim type misomeric structure of MP react with the -C-C- of acetylenic nitrile to give a spirosubstituted outer ring intermediate which isomerises to 1,2-dihydro-2-(4-oyl-cyanomethylidine)-1-methyl pyridine as the final product. This result provides for the first time chemical proof in support of the prediction based on physical measurement that MP has 35% aromatic character in the ground state.

On the basis of the preliminary work carried out in the area of the chemistry of gaseous ions, nucleophilic substitution at SP_3 carbon atom of nitro groups by amino functions and reduction of *trans*-double bonds by NH_4 and N_2H_7 ions have been reported. Relative acidities of hydrogen in the gaseous ions did not parallel known acidity data available from solution studies.

Metallurgy (NML)

Grain refinement and wrought aluminium alloys

(i) Studies on the effect of different thermal pretreatment schedules and effect of treating rates to recrystallization temperature on the recrystallization

kinetics and recrystallized grain size of Al-1.2% alloy have been completed. On the basis of the studies heat treatment schedules have been identified for achieving fine recrystallized grain size in Al-1.25% Mn alloy sheets produced from DC cast ingots.

(ii) Based on the earlier results on the grain size of Al-Cu-Zr alloys, a modified alloy has been prepared and processed for further investigation for achieving fine recrystallized grain size.

Splat cooling of aluminium alloys containing Pb, Bi, Cd
A modified splat cooling technique has been developed to study the impact of splat cooling on the properties of Al- and other alloys prone to oxidation during melting.

Biochemistry
At CSMCRI, biochemical changes under salt stress (10.000 and 20.000 ppm) were noted in 2 year old juncus grown in seashore mud. The culms were analysed for nucleic acid (RNA and DNA), total amino acids and protein. The growth parameters were found significantly affected by direct salinity of sea water.

Enriched sea water was used to grow Dunaliella seaweed. Employing ESW as culture medium for growing the alga the effect of salinity, light quality, light intensity and temperature on the growth of alga under culture room conditions were studied. Optimum growth was recorded at 4000 lux, white and blue light and 26°C temperature. It was also noted that temperature of 15°C and below retards growth considerably.

Laboratory culture studies on Sarconeme, a carrageenan yielding seaweed, were undertaken. Excised pieces from different parts of the plants were tested for vegetative propagation and in different culture media and it was found that the pieces used from basal part of the plant were vigorous in growth and showed maximum increase in biomass production. Under laboratory conditions, tetraspores from the mature plants were shed and germlings were raised under controlled conditions.

Fractions A and B were isolated from Entermorpha and their solution in trigol was prepared. These were tested against six strains of *Mycobacterium tuberculosis*. The testing was carried out at T.B. Hospital, Amargadh and CSMCRI. Only fraction A was found active against T.B. bacteria strain Nos. 250 and 282 at 200 and 400 g. concentration. Among the fractions tested against the laboratory test bacteria, fraction A shows maximum activity against 5 typhose. In the case of the fractions extracted from *Sargassum Johnstonii*, fraction A has been found active against the test microorganisms.

Molecular Enzymology (NCL)
Photoaffinity and amino acid specific reagents have been used to probe the active sites of the multienzyme citratelyase complex, a key enzyme in the

anaerobic metabolism of citrate. These studies have revealed details of the mechanism of action and of the structural features of the complex which has two component enzymes and an acyl-carrier protein.

Structure and genome organisation in higher plants (NCL)
Novel sequence organization patterns have been noticed for the first time in higher plants like rice, finger millet and pearl millet. These findings open up the possibilities of differences between plants and animals in respect of the role of repeated DNA sequences in gene regulation.

Studies on Vibrio cholerae (IICB)
Analysis of DNA repair mechanism, a phenomenon involving multiple gene functions including recombination genes, has made significant impact on the understanding of the molecular genetics of *Vibrio cholerae* and has raised several questions on the validity of the hypothesis on 'Coordinated incision - excision' scheme. A plausible correlation between toxinogenicity of this organism and other metabolic functions has been postulated. The DNA of the phage, considered to be the only differentiating agent to distinguish between classical vibrios and its biotype eltor, has been characterized and shown to have a unique S1 nuclease site repairable by T4 DNA ligase. The consequence of this structural anomaly in its biological role has been examined.

CDRI
A candidate bivalent cholera vaccine made from two genetically engineered attenuated strains of cholera vibrio, CD1 and CD3, was found (CDRI) to be non-toxic in rabbits and monkeys. The study of the phenomenon of adherence of cholera vibrio to intestinal mucosa in rabbits has shown that flagellar adhesive antigens are involved in such adherence which is found to be inhibited by glucose, sucrose and mannose.

Studies on host erythrocyte membrane in malaria infection
Changes in the erythrocyte membrane of the host as a result of malaria infection have been investigated. In the case of *P. knowlesi* infection in rhesus monkey, it was observed that even in the non-parasitised erythrocyte, the contents of phosphatidylethanolamine (35%) and phosphatidylserine (16%) in the outer surface of the membrane were much higher than in the membrane of normal erythrocyte, but these values become normal between 30-60 days post-treatment of the animal with chloroquine. The spectrum of the erythrocyte was also abnormal, perhaps due to transaminase-catalysed crosslinking of its two sub-units. In infected erythrocyte membrane ATPase activity showed a decrease of 50%; acid phosphatase and cholinesterase activities also showed a decrease, but there was a 2-fold increase in adenylcyclase. Chloroquine

treatment enhanced the activities of these enzymes. Development of immunity in monkeys by repeated infection with malaria was also found to affect the composition of the membrane of the erythrocyte; whereas the relative proportion of phospholipid components of the membrane remained unchanged, the cholesterol to phospholipid ratio was raised. Two new minor proteins of high molecular weight (75×10^4 daltons) were observed. A large proportion of the erythrocytes was transformed into echinocytes and stomatocytes. The transport of 2-deoxyglucose, DL-valine and L-leucine was not affected, but there was some change in the rate of metabolism of glucose.

Cellular and Molecular Biology (CCMB)

Regulation of cell division and malignant transformation

According to a comprehensive model proposed in the Centre, resting cells and dividing cells differ in the uptake of essential nutrients from the medium by the operation of a mechanism wherein one of the sites (site A) in the membrane operates for low-level uptake, and the second site (site B) for high level uptake. Sites B are closed in resting cells by the interaction of a transport inhibitory protein called the *I*-factor, but open in dividing cells. Thus, I^+ phenotype would mean that sites B are closed and the cell will be a resting cell, while cells that are I^- phenotypes can go through the division cycle. Malignancy, in terms of the model, would be the consequence of a situation where cells are not only phenotypically I^-, but also are no longer able to revert back to the I^+ state.

Efforts have been under way in CCMB to verify the predictions of this model, in particular, the existence of the transport-inhibitory protein. A protein (called *I*) that meets several of the criteria for the *I*-factor has been purified to homogeneity from normal rat liver. This was achieved using an affinity column prepared with antibodies raised against *I*, followed by molecular sieving on HPLC. It appears to have a molecular weight of 100,000 with two subunits of molecular weight of about 50,000 each. The protein was found to undergo self-aggregation, possibly with different affinities for the antibodies used. The protein does not contain any carbohydrates or nucleic acids. Amino acid analysis indicates the absence of tyrosine. The protein appears to be tissue-specific; it had no effect on the uptake of lysine in rat kidney or Yoshida Ascitic Sarcoma (YAS) cells, whereas it was able to inhibit the transport of lysine and several other amino acids into rat liver cells. Another interesting finding during the year was that antibodies raised against *I* were found to cross-react with the ascitic fluid of Zajdela Ascitic Hepatoma (ZAH). The ascitic fluid of ZAH, upon partial purification, was found to contain a protein that appears to have the same molecular weight and electrophoretic migration as the *I* protein from normal rat liver; it was, however, biologically inactive. Investigations are in progress to see if this protein from ZAH is a structurally altered form of *I*.

Malignant transformation by oncogenic viruses

RNA tumour-viruses, causative agents of several kinds of animal cancers, are known to enter the host cell, transcribe the viral RNA genome into DNA with the help of the enzyme reverse transcriptase (RT), contained in the virus, and integrate this DNA copy into the host chromosome leading to malignant transformation. In order to investigate the structure-function relationship of this crucial enzyme, detailed studies using RT isolated from avian myeloblastosis virus (AMV) have been carried out. Such studies are aimed towards the possibility of modulating or controlling the DNA copying process.

Detailed investigations have been conducted on the template-binding site of the enzyme and it is seen that microstructural variations in the DNA are distinguished by the enzyme. It has been found that the enzyme binds tighter to poly (rA): oligo (dT) than to poly (rC): oligo (dG). The rate of the reaction with poly (rA): oligo (dT) was lower than that with poly (rC): oligo (dG). These results suggest that recognition and a threshold binding is required for copying to occur, and also that, after reaching an optimal extent of binding, tighter binding of the template primer to the enzyme slows down the synthesis, probably by hindering the movement of the enzyme along the template.

With the recent excitement in the polymorphic structure of DNA and, in particular, on the relevance and the novelty of Z-DNA conformation, work at CCMB was also directed towards the effect of Z-DNA conformation on DNA synthesis by RT and by *E. coli* DNA polymerase I. The template activity of brominated poly (dG-dC), which adopts the Z-structure under physiological conditions, was compared with normal poly (dG-dC), which adopts the B form, for RT and for *E. coli* DNA polymerase I. It was found that brominated Z-DNA is totally inactive as a template for DNA synthesis; however, its affinity for both the enzymes is considerably higher than that of the B-form and it is a powerful inhibitor for the copying of the B-form. Control experiments have ruled out the possibility that bromination could be responsible for the absence of template activity. The situation would suggest the possibility that Z-DNA could potentially regulate DNA synthesis.

Interesting cell-surface proteins in malignantly transformed cells

The results of some studies reported in recent literature have shown interesting differences between virally-induced and chemically-induced tumours, e.g. the greater diversity of tumour-specific transplantation antigens (TSTA) in the case of the latter, the cause of which remains obscure. The precise biological role of TSTA is also unknown, primarily because of the non-availability of purified TSTAs. It has been possible to isolate, during the year, a protein from the surface of ZAH cells, which possesses all the properties of a TSTA. This protein which has subunits each of molecular weight 100 kilodaltons (kd), evokes solely an IgM response; it has been purified using Sephacryl

chromatography followed by Sepharose CL-6B. It is found to be a glycoprotein that gives total protection against complement-dependent lysis of ZAH cells *in vitro* and protection to animals against the tumour. Attempts to induce transplantation immunity by administering crude extracts or solubilized plasma membranes of ZAH cells were uniformly unsuccessful. Yoshida sarcoma cells injected in animals immunised by ZAH-TSTA grew progressively and killed the host at the same rate as those without ZAH-TSTA. Thus, the immunity provided by the isolated TSTA is tumour-specific. This TSTA, while exhibiting striking similarities with the tumour-associated antigen of Harris, is distinctly different from it, since it does not have the disulphide bridges between the two sub-units as the Harris antigen does. Attempts are under way to purify TSTAs from diverse sources.

It has also been possible to isolate a hitherto undescribed 35 kd protein from ZAH cell membranes; this protein appears to be tumour-specific. It has been seen to be an ectoplasmic plasma membrane protein that is carried into the ascitic fluid in small quantities; it can be easily washed from the cell surface by mild methods which do not affect cell viability. It does not induce transplantation responses and thus is not likely to be a TSTA. The discovery of this protein is reminiscent of several others of size 50-60 kd that have been reported from a variety of tumour cells and attempts are under way to examine whether these tumour specific proteins belong to a related class of conserved antigens and whether they perform some essential functions in malignant transformation or in controlling cell division.

Seminal plasmin

An antimicrobial protein isolated from seminal plasma, called seminal plasmin (SPLN), has been the subject of intensive study at CCMB and elsewhere in the recent past. A new method for purifying SPLN to homogeneity, using CM-Sephadex and HPLC has been worked out. A microassay, far more sensitive and with much less volumes, has also been worked out for assaying the activity of SPLN.

The effect of divalent cations on the antibacterial activity of SPLN has been explored. Ca^{2+}, Mn^{2+} and Zn^{2+} were found to relieve the antibacterial activity of SPLN in *E. coli*. The effect does not appear to be due to the production of any enzymes that degrade SPLN. Studies on the mechanism of inhibition of growth by SPLN suggest that the inhibition of the growth of wild type *S. cerevisiae* and its mutant YV 1160 occurs by SPLN entering these cells and inhibiting RNA synthesis therein. Immunological identification of SPLN in tissue extracts of the sex glands of the bull points to the presence of the protein in the accessory sex glands, while it is apparently absent in testes and epididymis, suggesting that SPLN may influence the physiological role associated with ejaculated sperm. The amino acid sequence of SPLN has been

determined by the Max-Planck Institut fur Biophysikalische Chemie, Goettingen. It is marked by the absence of sulphur-containing amino acids. The protein contains 48 amino acids, and has a molecular weight of 6385; its structural analysis reveals two helical domains and no beta conformation.

Photoacoustic spectroscopy (PAS)

A detailed study of the effect of the chloroquine class of antimalarial drugs on the intact malarial parasite was undertaken. The spectral features of hemin, the malaria pigment hemozoin, the parasites cultured in mouse blood in the presence and absence of specific antimalarial drugs, and of drug-sensitive and drug-resistant clones of the parasites, were compared. The results showed that the intact parasite contains the malarial pigment, aggregated hemin, and some residual hemoglobin. They also showed for the first time, by a direct method such as PAS, that the pigment is a non-covalent sequestered protein complex of hemin. The effect of the drug seems to involve a direct complexation with hemin to produce a stable complex which aids in the lysis of parasite cells *in vivo*. The detection of such a complex in the parasite affords a mechanism for the action of the drug. The hemin-drug complex has also been concurrently studied in the solution state and characterized to be a pi-pi overlap complex.

DNA synthesis in animal cells

Replication of eukaryotic chromosomes has been a subject of intensive study, and different forms of DNA polymerase—alpha, beta and gamma—have been identified. The alpha enzyme is the major DNA replicating enzyme, the beta enzyme has been shown to be involved in repair replication, and the gamma enzyme in mitochondrial DNA replication. Although these enzymes have been identified, their location within the cell has not been clearly established, and very little information is available on the regulation of DNA synthesis in mammalian cells. In any effort in this direction, a study of the distribution of DNA polymerase, in particular, the alpha, was attempted. Isolation of this enzyme from the plasma membranes of ZAH cells suggested that the enzyme is membrane-bound. Several observations indicated specific association of the enzymes with the detergent-insoluble residues of plasma membranes: (i) the enzyme activity could not be detected in the membranes without the use of nonionic detergents; (ii) the membranes could not be solubilised in the detergent by any conventional methods; (iii) fractionation on agarose columns demonstrated the presence of activity in the membrane fraction quite separate from the soluble cytoplasmic enzyme. Since it is known that the detergent-insoluble membrane skeleton forms a part of the "cytoskeletal framework", wherein processes such as mRNA translation and protein phosphorylation are known to occur, the association of DNA polymerase with the skeletal framework of plasma membrane becomes an interesting finding. Analysis of

the association of the enzyme with the cytoskeletal components in dividing and non-dividing cells has suggested that the enzyme is present as a free soluble fraction in the cytoplasm and also as particulate fraction associated with the cytoskeletal framework. It is proposed that the enzyme exists in the cell in three compartments: (i) free soluble cytoplasmic pool; (ii) particulate cytoplasmic pool attached to the cytoskeletal framework; and (iii) a particulate nuclear pool attached to the nuclear matrix. Association of the enzyme with the cytoskeleton may play an important role in the transport of the enzyme to the nucleus during cell division.

Chemical Biology (IICB)

Liposomes

Liposomes as carriers have been successfully used for producing saccharide-specific antibodies and the adjuvant role of liposomes has been demonstrated.

Neurobiology

Work relating to the mechanism of action of thyroid hormones in brain development, using organ cultures of embryonic chick brain, has shown that thyroid hormones mediate their effect by stimulating the synthesis/accumulation of tubulin and thus helping the differentiation of brain cells.

Also over 80% of the receptors for thyroid hormones in the embryonic chick brain are localized in the neurons, suggesting that these cells are the target cells for the thyroid hormones.

Enzyme immunoassay

An enzyme immunoassay technique has been evolved for the estimation of estriol in the urine of pregnant women for monitoring foetal health. This method could be of potential industrial interest.

Neuropharmacology

Spinal and peripheral mechanisms have been identified that are responsible for genesis of symptoms of Parkinson's disease. It has been discovered that dopaminoceptive muscarinic receptors exist on motor nerve terminals which could play a role in L-DOPA therapy of Parkinson's disease. A disbalance between motor output and recurrent inhibition in the spinal cord was found to be associated with tremor, an important symptom of Parkinsonism. New drugs with anti-Parkinson efficacy have been identified with sites of action at peripheral level, making it possible to avoid the hazardous side effects of current therapy.

Enzymology

A new type of peroxidase has been discovered which is present on the mitochondrial membrane of gastric cells. The enzyme is inhibited by EDTA

and the inhibition can be completely reversed by Zn^{2+}. The enzyme is also inhibited by Cl^-. This type of peroxidase has never been reported earlier.

Ecto-ATPase and ecto-cyclic AMP-dependent protein kinase activities have been demonstrated in maturing goat epididymal spermatozoa.

Reproductive biology

Aristolic acid was found to possess antifertility effects in lower laboratory mammals. A single dose on day 1 of pregnancy prevented implantation, while such a treatment on day 6 produced interception by the compound. It has a wide safety margin.

Anti-estrogenic nature of the compound is probably responsible for anti-implantation. This has previously been shown by direct experiments such as estrogen-uptake studies, competitive binding with estrogen or by uterotrophic assays, and indirectly by changes produced by the compound in uterine phosphatase levels.

The interceptive action was non-reversible by progesterone replacement. However, the compound failed to inhibit decidual cell reaction. It was hence suggested that the compound has a direct effect on fetal survival. The fact also gains support from the point that uterine alkaline phosphatase, which is associated with supplying nutrients to the fetus, diminishes significantly in aristolic acid treated animals.

Fungal toxins

A new mycotoxin, phaseolinone, has been isolated from a plant pathogenic fungus *Macrophomina phaseolina*. The toxin inhibits germination of a wide variety of food-grains. The structure of the compound has been elucidated and it is found to be a new sesquiterpene compound containing an epoxy group in its side chain.

Studies on plant insecticides (*RRL, Jorhat*)

During the year, 25 new plant species were collected from the adjoining area and from Chhela area in Meghalaya. Chemical examination of these led to several new structural types.

Tagitinin A and C and Hispidulin isolated from *Tithonia diversifolia* had been found to possess remarkable antifeedant action against *Philosania ricini*, as indicated by their median effective concentration (EC_{50}) values which were found to be 0.01603%, 0.01919% and 0.01936% respectively.

Metabolism of hydrocarbons by microorganisms (*RRL, Jorhat*)

Conclusive proof for the hypothesis of microbial uptake of insoluble hydrocarbons through a solubilization mechanism developed by the cells was obtained by isolation and functional characterisation of a hydrocarbon

solubilizing factor produced by the cells. It was seen that rate of hydrocarbon solubilization by the solubilizing factor could fully account for the rate of hydrocarbon uptake by growing cells. The hypothesis provided for the first time a generalized mechanism for the transport of insoluble substrates to cells.

Botany (NBRI)

Lichens

The studies on the genus *Anthracothecium* were continued and preserved type specimens numbering about 130, received from within the country and abroad, were examined.

Three new species, viz. *A. pseudocyphellatum* A. Singh, *A. pseudohimalayense* A. Singh and *A. pustulatum* A. Singh were recorded from Eastern Himalayas for the first time.

Ferns

(a) Filicinean Rhizome - Vascular Organization: Types of organization of the vascular cylinder of the rhizome in various species and groups of ferns and their distribution in different families have been studied as one of the dependable morphological criteria for interpretation of phylogeny and relationships.

(b) Vascular System in the Rhizome of Drynarioid Ferns: Studies on 14 species of drynarioid ferns have revealed that rhizome morphology provides characters which help to separate different species into two distinct groups and indicate some phylogenetic trends.

(c) Additions to the Indian Fern Flora: 123 species belonging to 47 genera in 18 families have been added to our knowledge of Indian fern flora, of which 36 species in 25 genera are endemic.

(d) Exploration of Endemic Ferns: 96 species (43 genera in 17 families) of ferns, endemic to India, have been recorded for the first time. Endemic ferns represent about 10% of the total number of known ferns in the country.

(e) New Cytotypes: Two new cytotypes of *Pteris vittata* Linn. triploid and pentaploid have been recorded for the first time.

(f) Growth substances from the leaf extract of *Lygodium flexuosum* have been detected and it has been concluded that inhibition of the terminal bud at the end of primary rachis branch is the result of auxin present in the lateral leaves of secondary rachis branches.

Angiosperms

The pollen anomalies in *Dombeya x cayeuxii* Hort. *ex* Andre were worked out which revealed that the abnormal types represent various developmental stages of pollen structure, arrested at a particular stage of pollen maturity due to cytological influence caused by hybridization. The investigations on the pollen morphology of 100 species had been completed with the objective of preparing a pollen album.

Gymnosperms

Sixty-five species belonging to 25 genera, analysed for the evolutionary comparison of DNA contents, brought out not only the broad differences among various orders but also interspecific differences.

Isolation and characterization of a flexuous rod-shaped virus (750 × 13 nm) from *Amaryllis*, showing light green and faint yellow stripes on leaves, has been achieved by a combination of polyethylene glycol precipitation followed by differential centrifugation and controlled pore-glass chromatography. Virus particles contain 5-6% nucleic acid.

Protein coat is made up of only one type of polypeptide with an approximate molecular weight around 32 kilodaltons. The virus has a narrow host range, probably because of no known vectors. The causal organism has been named 'Amaryllis cryptic virus' due to disappearance of symptoms from leaves of infected plants during acute summers and winters.

Studies carried out on a virus disease of *Gladiolus* revealed the presence of flexuous rod-shaped particles. Based on host range, biophysical properties, transmission by aphids, electron microscopy and serology, the virus has been identified as a strain of 'Bean yellow mosaic virus'.

CIMAP

Bursera delpechiana Poiss. *ex.* Engl.

The resinous exudate from the tree was found to contain terpenoids. The hexane extract of the resin gave on chromatography linalool and acetyl oleanolic acid. The ether extract also contains some triterpenoids which are under investigation.

Costus speciousus (Koen.) Sims

Chemical studies on the non-saponifiable portion of the hexane extract of the seeds were undertaken. Out of the eight compounds isolated, two were new benzoquinones possessing 20 carbon side chain. Their structure was established by physico-chemical methods. Two more quinones are under investigation. The known constituents, β-sitosterol and 5α-stigmast-9(11)-en-3β-ol were also isolated and identified. Structure elucidation of two additional compounds is under way.

A new sterol was isolated from the hexane extract of the roots. The structure elucidation of the compound is in progress.

Cryptocoryne spiralis Fisch. *ex* Weydler

A new sterol ester, 5β-stigmast-11-en-3β-ol palmitate was isolated and characterised by chemical and spectroscopic methods. The presence of the rare delta^{11} double bond in the sterol makes this compound a potentially interesting natural source for the synthesis of 11-oxygenated steroid hormones of medicinal value.

Duboisia myoporoides R. Brown
Chemical studies on the non-alkaloidal constituents of the leaves and stems of the plant revealed the presence of nine crystalline compounds. Of these, five were new compounds and were characterized by physico-chemical methods as 6-methyldotriacontane, hentriacontanyl tetratriacontanoate, 3-hydroxydotriacontan-28-one, 4-pentatriacontanone and 8-hydroxydotriacontan-30-one. Three compounds were known and identified as dotriacontanol, tetratriacontanoic acid and ursolic acid. One compound appears to be a keto triterpenic acid and its identification is in progress.

Echinops echinatus Roxb.
The phytochemical screening of the whole plant so far afforded five pure compounds—an open chain hydrocarbon, β-sitosterol, two alkaloids and a flavone glucoside and a mixture of two other alkaloids. The structure determination of all the pure compounds, except the conventional phytosterol β-sitosterol, is under progress.

Chloroform extract, found to contain both alkaloids and flavonoids, was separated into basic and non-basic parts, respectively. The partial work up of the non-basic part with the help of crystallization technique afforded a flavone glucoside having identical physical properties to those of apigenin 7-O-glucoside. Work on the basic part is in progress.

n-Butanol extract, showing positive test of alkaloids, flavonoids and devoid of saponin was separated into basic and non-basic parts. The basic fraction resulted in the isolation of two pure alkaloids, a low melting unstable one and the other of m.p. 107-8°C and also a mixture of two other alkaloids. All the alkaloids, except the first one, are polar and soluble in methanol, leading to difficulties in their isolation. However, they are found to be separable satisfactorily either on cellulose or on alumina.

Ephedra gerardiana Wall. *ex* Stapf
Leaves and stems of the plant, collected from U.P. Hills have been found to contain 0.14-0.8% alkaloids. Besides ephedrine and pseudoephedrine, they were found to contain several other alkaloids in traces.

Panax pseudo-ginseng Wall.
Saponin and non-saponin fractions of the rhizomes of the plant were separated. The non-saponin fraction was found to contain 10 compounds. Of these, one compound was identified as β-sitosterol, whereas others are under investigation. The saponin fraction showed the presence of at least 20 saponins. Their separation and identification are in progress.

Phyllanthus niruri L.
The plant is widely used in the treatment of jaundice and urinary disorders due to liver damage. Earlier investigation on this plant had shown the presence of

lignans. Since lignans are biologically active compounds, it has been proposed to isolate the active anti-hepatotoxic principles from the crude drug.

Pleurspermum angelicoides (DC) Clarke
The new bicyclic monoterpene, which was isolated earlier from the seeds of the plant, was characterized as 2-endo-5-exohydroxy borneol. It was provisionally designated as angelicoidenol and its structure was established by physical and chemical means. The compound constitutes the first example of a naturally occurring dihydroxybornane.

Rauvolfia canescens L.
The total alkaloids of the roots, present to the extent of about 1.56%, were found to contain serpentine as a major alkaloid in the strongly basic fraction. Further work on the isolation of the minor alkaloids of the roots and also ascertaining the possibility of its being an alternative source for ajamalicine is in hand.

Solanum torvum Swartz
The saponin fraction of *Solanum torvum* leaves furnished two new saponins. Characterization of these saponins is in progress.

Solanum verbascifolium L.
Solamargine has been identified.

Soymida febrifuga A. Juss.
It was reported earlier that the fruits of the plant contain the tetranortriterpenoids methyl angolensate, deoxyandirobine and 17-β-hydroxy-6α-acetoxyazadiradione. Further investigation led to the isolation of another minor tetranortriterpenoid whose structure has been established on the basis of IR, NMR and mass spectral data. This is a new entity belonging to the phragmaline group having a epoxytigloyl moiety. Isolation and identification of another minor compound are in progress.

Terminalia alata Steud.
Investigation of the chloroform extract of the root bark revealed the presence of arjunic acid and arjunolic acid. The methanolic extract contains tannins and saponins whose separation and identification are in progress.

A severe and novel disease of lemongrass (*Cymbopogon flexuosus*), Kerala local variety, was observed. The infection caused stunting and little leaf formation of the plants. The symptom appeared more or less like virus or mycoplasma induced symptoms in certain plants. Investigations indicated that the disease is caused by a *Balansia* species. The pathogen was isolated from

infected plants. Further studies are in progress. A new leaf spot disease of lemongrass varieties OD-19 and Kerala Local caused by *Drechslera victoriae* (Meehan and Murphy) Subram. *et*. Jain was observed which appears to be the first report of this pathogen on lemongrass. Another leaf spot disease of RRL-59, caused by *D. holmi* (Lutrell) Subram. *et*. Jain was also observed.

A wilt disease of *M. arvensis*, caused by *Pseudomonas* sp., was observed in experimental plots. A twig blight of *Rauvolfia serpentina* was observed to be caused by *Xanthomonas* sp. A blight disease of *Ammi visnaga* was observed to be caused by *Xanthomonas* sp. A severe leaf blight disease of senna (*Cassia angustifolia*) was observed in potted plants. The causal organism was isolated and identified as *Alternaria* sp.

Isolations from leaves of *Costus speciosus*, affected by leaf blight disease yielded *Dreschlera rostrata* and *D. longirostrata*. *D. rostrata* was not found to accumulate phytoalexins during the course of interaction with the host and therefore highly pathogenic on *Costus*. *D. longirostrata* was observed to accumulate phytoalexin-glyceollin II and III and thus non-pathogenic. *D. rostrata* produced active toxic metabolites on modified Fries medium, while *D. longirostrata* failed in producing any toxic substance. Thus, the role of phytoalexins in pathogenesis is established.

A detailed study on the physiology of *Phytophthora nicotianae* var. *nicotianae*, causing leaf blight of *C. speciosus* was carried out. Several physiological and biochemical changes were observed in diseased plants. Results of the investigations indicate that phenolic compounds, reducing sugars, total sugars, protein and ribonucleic acid (RNA) increased after 12 days of infection, but the quantity gradually declined as the symptoms advanced. The level of chlorophyll and non-reducing sugars decreased significantly in the infected tissue as compared to healthy tissue. However, levels of deoxyribonucleic acid (DNA) were not affected. Comparison of protein by electrophoresis showed no increase of any new protein of host origin, but quantitative changes occurred. Phenol oxidase and peroxidase enzyme activities were also increased during infection till 8 days, but declined thereafter.

Studies on the physiology of two strains of *Alternaria alternata* (Fr.) Keissler, causing leaf blight of *Hyoscyamus niger* and *H. muticus*, were carried out. The strains, when grown in Richard's medium, were found to produce significant amount of tenuazonic acid. Tenuazonic acid has already been reported to be a potent phytotoxic metabolite capable of inducing several metabolic changes during pathogenesis.

The toxicity of tenuazonic acid was tested on germinating seeds of *H. niger* and leaves of *H. muticus*. The toxin induced complete inhibition of root and shoot growth of the seeds at 100 μg/ml concentration, while it produced necrotic spot at 250 μg/ml concentration on leaves of *H. muticus*.

A new leaf blight disease of *Rosa damascena*, caused by *Curvularia* sp., was observed in the experimental field. The isolate was found to cause severe damage to the crop. Studies on the physiology of the infected plants were taken up. Significantly high peroxidase activity was detected in infected plants. The results thus indicated that peroxidase activity has a genesis by *Curvularia* sp. in *R. damascena*. A leaf spot, caused by *Alternaria* sp., was also observed on *R. damascena*.

Drugs & Pharmaceuticals (CDRI)

Clinical trial of curcumin from *Curcuma longa* rhizome (turmeric) in cases of rheumatism continued to show good results, improvement being observed in morning stiffness, grip strength and articular index. A study of the mode of action of curcumin in experimental inflammation in rat indicates that it affects the energy metabolism of the cells, inhibits lysosomal enzymes, restores serum transaminase to normal level and inhibits prostaglandin synthesis at the site of inflammation.

Clinical trial of the promising new neuroleptic, Centbutindole, has been expanded in collaboration with a pharmaceutical firm and is now being done in 7 hospitals. Concurrent six-month chronic toxicity studies in rats and beagle dogs have shown that the compound is safe.

Mefloquine is a new drug being developed under the aegis of WHO for treatment of chloroquine-resistant malaria caused by *Plasmodium falciparum*. It is under clinical trial in different parts of the world. With a view to generating data on its efficacy in the Indian population, clinical trial of mefloquine has been undertaken; it was found to be safe and well-tolerated in human volunteers and phase II trial (efficacy studies) will now be initiated.

In a study of the development of resistance to drug in malarial parasites, it was observed that *P. berghei* in rats can develop resistance to mefloquine, which is stable when maintained under drug pressure; the strain tends to lose infectivity to mice.

In a study of the sero-epidemiology of malaria, it has been demonstrated that antigen made from *P. knowlesi* schizont is suitable for serodiagnosis. A method has been developed for bulk production of the antigen which is being tried for the sero-epidemiology of human malaria in 8 centres in India in collaboration with ICMR.

Host-parasite relationship in malaria has been under study. It was found that acid hydrolases in the spleen of rats infected with *P. berghei* decrease initially and then increase progressively with the development of immunity. In contrast, mastomys and mice, which succumb to the infection, showed a considerable decrease in these enzymes during infection. Thus there appears to be a causal relationship between the resistance of the host to the infection and the levels of these enzymes.

Ring, trophozoite and schizont stages of *P. knowlesi* showed significant glucose-6-phosphate dehydrogenase activity. In *P. knowlesi* infected monkey erythrocyte the enzyme activity increased with increase in parasitaemia, but returned to normal 3 weeks after treatment with chloroquine, although the parasitaemia was cleared within 72 hours. G6-P-D level could, therefore, be of use in prognosis of malaria.

In a study of the effect of known antibiotics against malarial infection, it has been found that erythromycin had significant blood schizonticidal activity against *P. knowlesi* infected in rhesus monkey; at a dose of 30 mg/kg × 7 days, the parasitaemia was cleared and did not recur for the next 28 days.

Thrombopoietic effect of vasicine (RRL, Jammu)

One of the major claims about *Vasica* in the Ayurvedic system of medicine pertains to its ability to control post-partum haemorrhages and capillary haemorrhages of various types. The haemorrhagic disorders which are treated by this drug include *Raktpitta*, an Ayurvedic term associated with haemorrhagic disorders of wide variety such as bleeding associated with leukaemia, bleeding from lungs, nose, kidney, urinary bladder, uterus and rectum.

In trying to establish the mechanism by which vasicine controls capillary haemorrhages, RRL, Jammu has established that vasicine caused a significant increase in platelet count in normal rats, mice, rabbits, dogs in splenectomized rats and in busulphan-treated thrombocytopenic and hypoplastic rats.

The persistent effect was observed 3-4 days after oral or intramuscular administration of vasicin (2.5-20.0 mg/kg) and declined gradually to pre-drug level after the suspension of treatment. No concomitant increase in other blood cells was observed. Vasicin also increased the number and size of megakaryocytes (platelet precursors) in the bone marrow of normal rats and in animals depleted with busulphan.

In splenectomized rats vasicine causes significant increase in the platelet counts. This study illustrated that vasicine increased the platelet count by stimulating the formation of megakaryocyte in the bone marrow and not by stimulating its release from storage sites such as spleen.

It did not cause aggregation of platelets *in vitro* and *in vivo*, indicating that it has no effect on platelet function. This thrombopoietic activity of vasicine makes it a valuable tool in treating drug induced thrombocytopenia.

Entomology and Toxicology (RRL, Hyderabad)

Based on the work done on periwinkle *Catharanthus roseus* (*Vinca rosea*), catharanthus alkaloids as insect sterilants have been discovered for the first time.

A compound structurally similar to coumarin was tested against castor semilooper caterpillars and was found to have very good feeding deterrent action. This has a potential to be developed as a feeding deterrent.

New potential pesticidal compounds RPR-I, II and III (new isomers of organo-phosphorus) and N-formyl-X-*n*-propyl benzyl amine have been developed based on evaluation of structure-activity relationship.

Industrial Toxicology (ITRC)

In order to understand the mechanism of manganese neurotoxicity, the nature of ^{54}Mn binding protein in serum, liver and brain tissue was investigated. It was observed that ^{54}Mn was bound to a homogeneous single band protein having molecular weight of 6.3×10^4 daltons. It was glycoprotein in nature without sulphydryl groups. ^{54}Mn binding protein was identical in nature in all the three biological media and is the first evidence of a ^{54}Mn binding protein for these tissues. Thus, it appears that the same protein is involved in transport and accumulation of manganese in the tissues. *In vitro* studies on ^{54}Mn and lead interaction on their binding with rat, serum, liver and brain proteins showed no competition of ^{54}Mn with lead for common binding sites. However, their interaction altered the affinity of tissue proteins to bind ^{54}Mn and lead. Excess lead in the body interferes with the uptake of Mn in liver and consequently its excretion through biliary passage to result in increased blood Mn levels in humans occupationally exposed to lead and manganese.

A number of neurotoxic metals alter brain (Na^+-K^+) ATPase, thus affecting the excitability of nervous tissue. The activity of K^+-activated-*p*-nitrophenyl-phosphatase of (Na^+-K^+) ATPase was investigated in order to understand the site and mechanism of inhibition due to neurotoxic metals. Silver, mercury, copper, cadmium and lead were most potent inhibitors of this enzyme.

The increasing use of polymeric material poses health hazards not only to workers but also to growing children. Capabilities were developed to expose the growing animals to various toxic monomers during gestation and lactation periods. Using the neurotransmitter-receptor binding screen developed earlier by ITRC, neurotoxic effect of some widely used chemical were studied after gestational and lactational exposure. Monomer acrylamide and styrene used in the manufacture of polyacrylamide and polystyrene were found to affect the sensitivity of dopamine and muscarinic receptors.

Evidence was presented to show that neurotoxic monomer acrylamide is metabolized in rats and is excreted as mercapturic acid and cysteins-S propionamide in the urine estimation of urinary level thioethers may help to monitor biologically the acrylamide exposure among industrial workers and general population which may come in contact with this monomer.

Jute batching oil (JBO) is a product derived from distillation of crude petroleum and is used as an aqueous emulsion in jute mills of India. Depending upon viscosity, boiling point, etc., it is fractionated and marketed in two varieties, FDA and non-FDA (synonym Pre-FDA) variety. The former is approved by Food & Drug Administration Department, USA, for preparation of jute textiles, whereas the latter is preferred by USSR and East European countries.

Non-FDA (or Pre-FDA) variety of jute batching oil (JBO), reported earlier to be carcinogenic and cocarcinogenic in Swiss albino mice, seems also to possess the ability to initiate the process of tumourigenesis, i.e. to increase the susceptibility of the animals to develop skin tumours after repeated cutaneous exposure to a cocarcinogen like TPA (tetradecanoyl phorbolacetate). FDA variety of JBO reported earlier to be non-carcinogenic in Swiss albino mice has been found to be cocarcinogenic in two-stage mouse skin cocarcinogen assay system. As compared to standard skin tumour promoter TPA, JBO seemed a stronger cocarcinogenic agent in test doses. The types of tumours promoted by JBO were noted to be benign (i.e. squamous cell papillomas and keratoacanthomas) except a locally malignant fibrosarcoma in one animal.

Previous work on the immunotoxicologic evaluation of endosulfan in rodents revealed thymus atrophy, depletion of cortical thymocytes together with alterations in the antibody synthesis. To further investigate the basis of endosulfan immunotoxicity at cellular level, the oxidative metabolism of various immunocompetent cells studied under *in vitro* conditions showed diminished cell respiration, especially of thymocytes at 10^{-3} *M* concentration of endosulfan. However, at concentrations ranging from 10^{-4} to 10^{-7} *M*, endosulfan showed several-fold stimulation of cellular respiration, which was dose dependent. Using rat thymocytes as an *in vitro* test model, a modulatory effect was observed on the oxidative metabolism of thymocytes in the presence of substrates of carbohydrate metabolism, regulators like cyclic AMP and cyclic GMP and probable protectors such as foetal calf serum and glutathione (reduced), which is suggestive of a common mechanism involved in these biochemical reactions of endosulfan mediated immunotoxicity.

Using a battery of immunological test assays, the effect of respirable agate dust (Khambhat, Gujarat) on the immune system was assessed in rodent model system. There was no alteration in the delayed hypersensitivity reaction in agate exposed animals to ovalbumin. Nevertheless, the animals became sensitive to endotoxin of *E. coli* lipopolysaccharide and agate dust affected the macrophage chemotaxis under *in vivo* condition. Furthermore, decrease in IgM and IgG secreting spleen cells with corresponding serum HA titre was observed even after one month of agate exposure, indicating suppression of humoral-mediated immunity. These preliminary findings may help to explain

the increased incidence of pulmonary infections reported in an earlier survey condcuted in agate workers by ITRC.

Prolonged exposure to quinalphos caused cholinergic effects in domestic goat. Discontinuation of further exposure and rest, however, restored normalcy in animals. Long-term treatment of endosulfan produced organochlorine poisoning, which was associated with morphological and enzymatic changes in animals. Treatment of animals with carbaryl, endosulfan and phosphamidon alone and in combination with CCl_4 did not suggest a synergistic effect. Combined treatment of DDT and BHC, however, produced meaningful alterations in the activity of ATPase and cholesterol. Screening of 22 insecticides using *in vivo* cytogenic assays (aberration of chromosomes and micronucleus test) did not suggest them as potential mutagens.

The effect of coal-quartz mixtures, containing graded amounts of coal or quartz on peritoneal macrophage cultures and plasma-free sheep erythrocyte suspensions was studied. A stoichiometric relationship was observed between the quartz content of coal-quartz mixture, and the extent of extracellularly liberated lactate dehydrogenase (LDH) and acid dye uptake by macrophage monolayers. Total LDH of the monolayers plus supernatant remained unaltered following exposure to different dust mixtures. The dusts containing higher concentration of quartz also produced greater degree of hemolysis. Coal did not inhibit the quartz-induced macrophage cytotoxicity or erythrocyte hemolysis.

Food Science (CFTRI)

Pheromones are secretory products of insects serving as sex attractants. An unsaturated yellow oil (at room temperature) with the characteristic smell of an ester has been prepared from tallow by the modification of its fatty acid. It has been found to resemble the pheromone of *Tribelium castaneum*, one of the most resistant pests of foodgrains. Collection of insects in one place due to the action of this compound would help in fumigation, thereby showing the potential for combined use of pheromones and fumigants for storage pest control.

New compounds based on silicophosphates, namely, hydrogen silicophosphates (CSP-332H) and copper silicophosphates have been synthesised and tested against major storage pests such as *Tribolium castaneum*, *Rhizopertha dominica*. *Oryzaephilus surinamensis* and *Trogoderma granarium*. Hydrogen silicophosphate caused 100% mortality, when mixed with foodgrains at minute levels (1% or even less). The possibilities of using silicophosphates as insecticides had not been explored in India so far.

Rice varieties richer in lysine and bran oil as well as resistant to milling breakages are aimed at in-breeding programmes. Also, rice varieties with higher protein content are not associated with proportionately higher lysine

content. A chalky variety (FT 1990) has been identified to overcome these disadvantages through soil enrichment with nitrogen. Four varieties (CRHP-8, IRAT-10, Lagore and Rajbhog) relatively richer in aleurone layers than commercial varieties have also been identified to serve as germ plasm for developing varieties with grains rich in oil. Another variety, S-701, was found to retain the scutellum even at 6% polish, indicating the potential for obtaining nutritious milled rice even in commercial milling practices.

Contamination of commercially marketed vegetable oils with aflatoxin has been reported frequently. The protective action of groundnut oil, refined oil and safflower oil against aflatoxin B_1 has been investigated. Histopathological examination of liver, kidney and heart of animals fed these vegetable oils in basal diets for three months indicated the superiority of groundnut oil over the other two oils in protecting the animals against the toxic effect of aflatoxin B_1.

Oxidative deterioration of edible oils is an undesirable change noticed during storage. In basic studies undertaken to overcome this defect, raw groundnut oil has been found to keep better with traces of moisture. than without any moisture, due to the presence of native phosphatides. This finding is likely to open the venue for incorporating natural phosphatides in vegetable oils to check deterioration during transportation and storage.

Tertiary butyl esters of phenylacetic, phenoxyacetic and cinnamic acids (yields 55-70%) and the corresponding α-terpinyl esters (yields 25-30%) have been prepared by extending the method developed earlier for alkyl halide. Chlorination of carveol using Lee's reaction has been used to work out conditions to obtain carvyl chloride of high optical purity.

An improved method of deoxygenation of oxiranes using lithium has been developed. A study of the reaction of sodium with substituted oxiranes indicated the formation of ion radical intermediates which subsequently yielded alcohols, ketones and dimeric compounds. Continued work in cell membrane biology has shown that in retinol-deficient rats, less of sialic acid is released by RBC after sialidase treatment. Goblet cell counts are significantly reduced, and purine nucleotide phosphorylase activity increases. The bactericidal activity of leucocyte of retinal deficient rats was also greater than that of controls.

In basic studies undertaken to gain an insight into the metabolic effects of the active principles of spices, capsaisin (bitter principle of chilli) used at 15 mg% per rat in diets did not affect amino acid absorption (reflected by tracer studies). Curcumin at 0.5% and capsaisin at 15 mg level per rat in diet enhanced the secretion of bile, but its dry matter content was low. The concentration of cholesterol and of bile acids was significantly enhanced by higher doses of curcumin.

RRL, Trivandrum

Gas chromatographic analyses of ginger fat and clove lipids from various varieties were made in order to identify the differences in the constituents. A detailed study concerning various chemical changes taking place during pepper ripening has been undertaken in order to understand the molecular mechanism concerning the blackening of pepper. Fractionation studies were made on palm kernel proteins. The flavour constituents of roasted coconut gratings were studied. Studies were made on the effect of parboiling on the textural characteristics of cassava. Lipid extractability and fatty acid composition of the tuber *Colens parviflorous* were studied. Histological studies were made on the pattern of deposition of starch grains in the cells of cassava, turmeric and ginger. Histochemical studies were made on the localisation of hydrocyanic acid in cassava.

Structure-property relations of banana fibres, fibres from different parts of the coconut tree and palmyrah fibres have been studied. This study will help understand the large variations in predicted and observed properties and scatter in properties of these fibres as well as help in improving the strength of the fibres.

Desiccating characteristics of coconut pith were studied and were compared with those of silica gel. Systematic studies on structural, chemical and physical properties of coconut pith, coconut shell char and sawdust were made in order to improve their briquetting characteristics.

GENERAL

Smt. Indira Gandhi, Prime Minister and President, CSIR, inaugurated the 32nd conference of Directors of the national laboratories of CSIR, held in New Delhi during 25-27 June 1982.

The Society of CSIR met on 3 November 1982, under the chairpersonship of the Prime Minister.

Four meetings of the Governing Body, CSIR, were held on 30 April, 25 June and 21 October 1982 and on 11 February 1983.

The Planning Division of the CSIR headquarters was concerned with the formulation of the Annual Plan 1983-84. Emphasis was laid on the multi-institutional programmes identified in the areas of oceanography, electronics, utilization of coal and biotechnology. The Division was also responsible for bringing together experts of national laboratories and other R&D institutions/ departments participating in the multi-institutional programmes—NML, RRL (Bhubaneswar), CFRI and SAIL R&D Unit, for instance, so that task forces could be set up for implementing specific programmes identified for each participating institution. As a result, the national laboratories could formulate well-identified and time targeted programmes in these areas with clear and terminal objectives in view. In addition, the Division coordinated the steps involved in the establishment of two new constituents of CSIR, viz. the Institute of Microbial Technology (IMT) at Chandigarh and a CSIR set-up at Palampur (Himachal Pradesh).

The Technology Utilisation Division (TUD), CSIR Headquarters, maintained linkages with government departments, viz. the Central Ministries of Agriculture, Industry, Petroleum and Chemicals and the Department of Science and Technology (DST), Directorate General of Technical Development (DGTD), National Research Development Corporation of India (NRDC), etc.

The Division represents CSIR on the Technical Evaluation Committee (TEC), Licensing Committee (LC), Project Approval Board (PAB) of the Ministry of Industry and the Foreign Investment Board (FIB) of the Ministry of Finance. During the year, CSIR examined 434 applications for foreign collaboration—1935 for industrial licences and 191 composite applications. The Division participated in 12 FIB, 41 TEC, 25 PAB, 43 LC-MRTP and 50 LC meetings.

One hundred and fifty two new applications for recognition of R&D units. 101 renewal proposals and 10 applications for delicensing of industries based on indigenous technologies were received, examined and comments communicated. The Division represented CSIR in 4 meetings of the Screening Committee of R&D Applications, 4 meetings of Delicensing Committee and 11 meetings for consideration of proposals under section 35(2B) of Income Tax Act.

Under the Protocol on Science & Technology Cooperation, a delegation from the Scientific Research Council of Iraq led by Dr Mohammed Ayoub Elizzi, Director General of the Building Research Centre, Baghdad, visited India during 22-29 December 1982. A Memorandum of Understanding was signed on the conclusion of the visit specifying areas for R&D cooperation, training and visits. Dr I.B. Gulati, Director, IIP, Dehradun, signed the memorandum on behalf of CSIR.

A protocol on collaboration between CSIR and the Nigerian Building and Road Research Institute was signed in New Delhi in January 1983. Dr G.S. Sidhu, DGSIR and Secretary to the Government of India signed on behalf of CSIR and His Excellency T.O. Asiwaju-Dada, High Commissioner of Nigeria in India signed on behalf of the Nigerian Government in the presence of the Prime Minister of India and the President of Nigeria.

An Indo-FRG agreement involving assistance of the order of DM 52.25 lakh was finalized in July 1982 through exchange of letters for two of RRL(Bhu)'s projects: (i) development of a dressing process for two complex sulphide ores and hydro- and electro-metallurgical extraction of precious metals, and (ii) development of a dressing and agglomeration process for fine grained chromites.

An arrangement between CSIR and the International Development Research Centre (IDRC) was finalised in September 1982 providing for cooperative research activities and exchange of information in support of research in areas that fall within the mandates of the two organisations and for providing expertise and training facilities for IDRC projects.

The 12th Meeting of the Commonwealth Science Council (CSC) was held in Kuala Lumpur during 23-30 August 1982. India was represented by Dr G. Thyagarajan, Director, RRL, Hyderabad and Shri K.N. Johry, Joint Adviser (International Science Collaboration), CSIR Headquarters.

H.E. Academician G.I. Marchuk, Chairman, State Committee for Science and Technology and Deputy Prime Minister, USSR, accompanied by a delegation of experts visited India during January 1983 at the invitation of Prof. S. Nurul Hasan, Vice-President, CSIR. He visited important centres of R&D in India and held discussions with heads of scientific agencies, Vice-President, CSIR and the Minister of State for Science and Technology. Ongoing S&T Programmes were reviewed and future areas of cooperation between India and USSR explored.

The Japanese National Secretariat of the Association for Science Cooperation in Asia (ASCA) organized a seminar on 'International R&D Cooperation' in Tokyo during 2-5 March 1983 under the auspices of the Science and Technology Agency and Patent Office of Japan. Shri K.N. Johry, CSIR and Dr K.V. Swaminathan, Director, DST, attended the seminar. The

ASCA countries which participated included China, Indonesia, Japan, Korea, Philippines and Thailand.

The above activities were coordinated by the International Science Collaboration Unit of CSIR Headquarters.

The Division for Scientific and Technical Personnel (DSTP) of the CSIR Headquarters brought out 8 issues of *Technical Manpower* during the year. Some of the important studies published were: High Level Scientific & Technical Personnel—Outturn in India and USA, 1977; Women in the Scientists' Pool (Indian and foreign qualified/trained); Transfer of Know-how through Expatriate Nationals (TOKTEN) Project; Indians Abroad Register (analysis of registrants registered during 1982), and Scientists' Pool. In addition, 8 issues of Pool supplement containing particulars of persons selected to the Scientists' Pool, and 5 issues of Indians Abroad Directories incorporating particulars of scientists, technologists, engineers and medical personnel with foreign qualifications/training were also brought out.

Four hundred and seventeen persons were selected to the Scientists' Pool during the year 1982-83. Since its inception in 1958, a total number of 6,946 persons joined the Pool. The number of Pool Officers working as on 31 March 1983 was 425.

A total of 393 scientific and technical personnel were enrolled in the Indians Abroad Register during the year. In addition, 13 social scientists were also registered. With a view to enlarging registration in the Register, 315 important organisations in India were requested to supply names and addresses of eligible persons. The Specialists' Register had enrolled 30,400 specialists. Names and particulars were suggested for consideration of 50 posts notified to the Division. Under the TOKTEN project, 22 experts arrived in India and completed their assignments.

About 2 million proformae of Degree Holders and Technical Personnel (DHTP) were collected by DSTP during the General Census 1981. During 1982, a number of meetings of the Advisory Committee and the Working Group for DHTP Survey were held and the tabulation plan of the survey was finalised. The coding of proformae of Scientific and Technical Personnel has been undertaken and the work assigned to the Indian Society of Agricultural Research Statistics, New Delhi. Work on data processing has been undertaken by the Planning Commission.

Survey of Scientific and Technical Personnel who did not fill in the DHTP proformae during the 1981 Census has been completed for Calcutta and Delhi.

The activities of the Extra-Mural Research (EMR) Division of the CSIR Headquarters cover financing of research projects, award of fellowships/associateships, grants for symposia/seminars, journals in Indian languages for popularization of science and foreign travel grants to research scholars and award of Bhatnagar Prizes.

Four hundred and sixty nine research schemes continuing from earlier years were renewed for financial assistance and grants provided. In addition, work commenced on 70 new research schemes, approved earlier. Thirty four scientists availed of the Emeritus Scientist grant for various periods. One hundred and forty one Research Fellows, 243 Senior Research Fellows and 46 Research Associateships were sanctioned for the schemes in progress during the year.

The number of direct research fellows/associates as on 1 March 1983 receiving assistance from CSIR was 2958 in academic and research institutions other than CSIR. Of these, 1589 were Junior Research Fellows (JRF), 1266 were Senior/Post-Doctoral Research Fellows (SRF/PDF) and 103 Research Associates (RA). Besides, there were about 400 Research Fellows/Associates in CSIR Laboratories.

Two hundred and fifty four CSIR Research Fellows were awarded Post-Doctoral Fellowship on their receiving Ph.D. degree; 338 fellows submitted their theses for Ph.D. and 408 Junior Research Fellows were promoted as Senior Fellows during the year. The number of fellowships completed/terminated due to resignation was 1094.

Under the scheme of travel grants to young research scholars for presenting papers at international conferences, seminars, etc., grants amounting to Rs 50,000 were given to 10 candidates.

Grants amounting to Rs 4.33 lakh were also given to 58 learned societies for organisation of symposia/seminars during the year 1982.

Grants were given to 17 Indian language periodicals primarily devoted to popularisation of science through Indian languages. Of these, four were in Malayalam, three in Bengali, two each in Tamil, Hindi and Marathi and one each in Gujarati, Assamese, Oriya and Kannada. The grants totalled Rs 1,35,500.

CSIR participated in the Indian Trade Exhibition, London (November 1982) organised by the Trade Fair Authority of India and the Indian International Trade Fair 1982 (4-14 November) at Pragati Maidan, New Delhi and again during 19 November-5 December 1982 during the IX Asian Games.

At the request of the Parliamentary Science Forum, an exhibition was organised by CSIR in the Parliament Annexe for Members of Parliament during 23 February-1 March 1983. The exhibition was inaugurated by Shri Buta Singh, Union Minister for Parliamentary Affairs, Works and Housing and Sports. Several other ministers and MPs visited the exhibition and evinced keen interest in the achievements displayed by the national laboratories.

CSIR participated in the Science and Technology exhibition organized during the Non-Aligned Meet (NAM) held during 7-12 March 1983. The Public Relations Unit of the CSIR Headquarters coordinated the organisation of these exhibitions.

GENERAL

Polytechnology Transfer Centres

CSIR Polytechnology Transfer Centres (PTC) functioning in 10 State Capitals, viz. Ahmedabad, Bangalore, Bhopal, Bombay, Calcutta, Hyderabad, Lucknow, Patna, Shillong and Trivandrum provided 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 period April 1982 to March 1983, the Project Officers of PTCs visited/revisited nearly 2000 industrial units and identified about 1300 technical problems; about 900 were solved. The PTCs attended to more than 2,300 technical and general enquiries from entrepreneurs, associations of industries and other interested parties.

HONOURS & AWARDS

Shri H.N. Siddiquie of NIO, Goa has been awarded the 'Padma Shri' and was also elected Fellow of the Indian National Science Academy.

Dr A.P. Mitra, Director, NPL, New Delhi was selected for the C.V. Raman Award (1980) for experimental research in physical sciences jointly with Prof. P.T. Narasimhan of IIT, Kanpur. This Award is instituted by Hari Om Ashram Trust, Nadiad and is administered through the University Grants Commission.

Dr A.P. Mitra, Director, NPL, New Delhi received the 1982 FICCI Award. He shares the award in physical sciences, including mathematics, with Prof. K.L. Chopra of IIT, New Delhi.

Dr Harish Bahadur of NPL, New Delhi, has been awarded the Homi Bhabha Fellowship in Physics.

Dr M.V.M. Satyanarayana Rao of NGRI, Hyderabad, received the Young Scientist Award from the A.P. Akademy of Sciences for his contributions in the field of geophysics.

Dr L.K. Doraiswamy, Director, NCL, Pune, has been awarded the honorary degree of D.Sc. of the University of Salford, Salford, U.K. He has also been awarded the S.H. Zaheer Medal for 1983 of the Indian National Science Academy, New Delhi.

Prof. B.K. Bachhawat, Director, IICB, Calcutta, was awarded the 1980 Sir J.C. Bose Award of the UGC-Hari Om Ashram Trust, for Life Sciences.

Dr (Mrs.) Vidya Gupta of NCL, Pune, has been awarded the Sri A. Krishnamurthi Award by the Society of Biological Chemists (India) for the year 1981-82.

Dr N.R. Mashelkar of NCL, Pune, has been awarded the 1982 Herdillia Award by the Indian Institute of Chemical Engineers.

Dr D. Chakravorty of CGCRI, Calcutta, has been elected a Fellow of ıdian National Science Academy.

Dr J. Mukherji of CGCRI, Calcutta, was invited by the Max Planck Society, West Germany, as a Senior Guest Scientist for a period of 3 months—April to June 1982—in the Materials Science Laboratory at Stuttgart.

Dr K.S. Rajagopalan, Director, CECRI, Karaikudi, was elected President of the Society for Advancement of Electrochemical Sciene & Technology for the year 1983-84.

Dr S.K. Basu, Director, CMERI, Durgapur, was elected Vice-President of the Indian Society of Engineers, Calcutta for 1982.

Prof. P.K. Rohatgi, Director, RRL, Bhopal, was elected a fellow of the Institution of Engineers India.

Shri H.N. Siddiquie, Dr R. Sen Gupta, Dr A.H. Parulekar, Dr E. Desa, Shri D.V. Rama Raju, Shri M.C. Pathak and Shri S.G.P. Matondkar of NIO, Goa, and Dr Amitava Sengupta of NPL, New Delhi, who participated in the

first Indian Expedition to Antarctica, have been awarded merit promotion to the next higher grade.

Shri B.D. Baliga of CMRS, Dhanbad, has been conferred the Rungta Award for 1982 by the Mining Engineering Association of India.

Dr Satyawan Singh, Shri R.C. Nandi, Dr J.P.S. Sarin and Dr N.M. Khanna of CDRI, Lucknow, have jointly received the award of the Inventions Promotion Board for the development of new cervical dilators (Isaptent I & II).

Dr D.S. Bhakuni of CDRI, Lucknow, has been elected a Fellow of the Indian Academy of Sciences, Bangalore.

RRL, Jorhat, was chosen by the Federation of Indian Chambers of Commerce and Industry (FICCI) for its 1982 Institutional Awards for outstanding achievement in Science & Technology. RRL, Jorhat, shares the award with the National Institute of Nutrition, Hyderabad.

Prof. P.K. Jena, Director, RRL, Bhubaneswar, received the 1982 FICCI Award for Engineering Science & Technology transfer jointly with Prof. P.K. Katti of IIT, Bombay.

Prof. P.K. Jena, Director, RRL (Bhu), has been nominated a member of the Jury of International Kalinga Prize (UNESCO).

STATISTICAL TABLES

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
FINANCIAL DATA

Particulars	Actual Expenditure for 1980-81			Actual Expenditure for 1981-82			Actual Expenditure (Tentative) for 1982-83		
	Non-Plan	Plan	Total	Non-Plan	Plan	Total	Non-Plan	Plan	Total
1 Central Administration									
(i) Pay & Allowances, Contingencies, Maintenance	146.769	5.968	152.737	150.624	12.543	163.167	180.930	7.953	188.883
(ii) Headquarters Technical activities	18.328	1.244	19.572	6.270	12.557	18.827	7.288	15.181	22.469
(iii) Miscellaneous Pension, advances, etc.	285.623	20.359	305.982	382.557	20.397	402.954	532.278	36.054	568.332
Total Central Administration	450.720	27.571	478.291	539.451	45.497	584.948	720.496	59.188	779.684
2 Laboratories	2743.450	2088.976	4832.426	4052.657	2986.170	7038.827	4621.498	3496.119	8117.617
3 Scientists' Pool	46.320	—	46.320	42.717	—	42.717	64.315	—	64.315
4 Research Schemes, Scholarships & Fellowships	—	339.974	339.974	—	488.508	488.508	—	590.747	590.747
5 Industrial Research Associations	52.864	20.790	73.654	59.045	14.420	73.465	53.490	31.128	84.618
6 Pilot Plants	148.745	—	148.745	65.932	—	65.932	85.070	—	85.070
7 Residential Buildings	44.035	149.017	193.052	58.533	219.033	277.566	64.262	373.107	437.369
Grand Total:	3486.134	2626.328	6112.462	4818.335	3753.628	8571.963	5609.131	4550.289	10159.420

NON-PLAN—SUB-HEADWISE BREAK UP OF ACTUALS FOR THE YEAR 1982-83

(Rs. in lakhs)

Labs/Institutes	RECURRING							CAPITAL					Gross Total Cols (8+13)
	P1-Pay of officers	P2-Pay of Estt	P3-Allowances	P4-Contingencies	P6-Maintenance	P7-Chem. App & Equipt	Total Rec	P5(4) (ii) Lib Books	P5(3) App. & Equipt	P5(4) (i) Furn	P5(4) (iii) Vehicles	Total Capital	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Physical Science Group													
NPL	38.650	45.120	105.099	31.500	3.897	30.000	254.266	9.174	24.999	—	0.726	34.899	289.165
CEERI	16.250	21.130	38.000	8.620	3.498	15.160	102.658	5.000	1.000	—	—	6.000	108.658
CSIO	17.000	26.000	57.000	20.036	2.491	25.400	147.927	2.788	4.209	—	—	6.997	154.924
NGRI	16.103	22.321	56.377	19.147	1.886	31.811	147.645	3.240	1.832	—	0.870	5.942	153.587
NIO	10.520	14.914	31.016	8.800	1.500	85.660	152.410	4.199	—	—	—	4.199	156.609
Total I	98.523	129.485	287.492	88.103	13.272	188.031	804.906	24.401	32.040	—	1.596	58.037	862.943
II. Chemical Science Group													
NCL	41.206	33.794	89.800	32.729	3.271	29.000	229.800	13.000	34.999	2.500	1.509	52.008	281.808
CECRI	17.687	23.113	48.770	12.000	1.193	20.000	122.763	2.750	2.987	—	0.850	6.587	129.350
CS&MCRI	13.230	12.760	32.010	5.200	0.601	9.580	73.381	3.299	—	—	—	3.299	76.680
RRL, Hyd.	29.890	35.820	87.288	23.500	2.723	28.577	207.798	6.250	21.398	—	0.594	28.242	236.040
RRL, Jorhat	14.130	16.630	37.790	8.000	1.750	10.460	88.760	5.998	—	—	2.422	8.420	97.180
CFRI	47.176	45.027	99.170	23.577	4.067	14.501	233.518	2.859	—	—	3.715	6.574	240.092
IIP	22.973	23.082	60.958	16.102	2.151	16.814	142.080	5.007	—	—	0.425	5.432	147.512
Total II	186.292	190.226	455.786	121.108	15.756	128.932	1098.100	39.163	59.384	2.500	9.515	110.562	1208.662
III. Engineering Science Group													
NML	33.540	36.778	83.682	20.530	2.092	14.850	191.472	4.996	5.993	—	—	10.989	202.461
CG&CRI	17.150	20.550	54.330	11.000	1.330	12.500	116.860	3.096	3.000	0.153	—	6.249	123.109
CMRS	25.277	14.210	41.520	10.100	1.733	4.954	97.794	2.750	0.430	—	—	3.180	100.974
CMERI	31.973	36.415	81.510	16.480	3.004	13.368	182.750	4.014	—	—	(−)0.318	3.696	186.446
NEERI	13.680	19.910	49.593	11.000	1.390	7.839	103.412	1.990	0.708	—	(−)0.012	2.686	106.098
NAL	31.500	38.700	97.250	31.600	2.712	34.850	236.612	13.088	6.314	—	2.571	21.973	258.585
NTAFC	3.360	5.057	9.210	—	—	18.380	36.007	—	2.335	—	—	2.335	38.342
RRL, Bhub.	9.244	7.240	20.120	9.119	2.630	8.650	57.003	3.960	—	—	—	3.960	60.963
SERC, Roorkee	4.800	4.710	11.610	3.300	0.500	4.200	29.120	1.050	—	—	—	1.050	30.170
SERC, Madras	5.760	3.320	13.920	4.000	—	9.500	36.500	2.000	—	—	—	2.000	38.500
CSIR Madras Complex	0.854	3.760	7.441	5.200	1.547	—	18.802	0.050	—	—	—	0.050	18.852
RRL, Trivandrum	1.450	1.530	4.410	2.100	0.300	0.400	10.190	0.950	—	—	1.156	2.106	12.296
CSIR Cochin Complex	—	—	—	—	—	—	—	—	—	—	—	—	—
CRRI	13.136	14.501	36.576	10.991	1.004	3.684	79.892	3.001	—	—	—	3.001	82.893
CBRI	20.762	20.898	44.000	8.600	0.800	9.900	104.960	1.252	—	—	—	1.252	106.212
Total III	212.486	227.579	555.172	144.020	19.042	143.075	1301.374	42.197	18.780	0.153	3.397	64.527	1365.901
IV. Biological Sciences Group													
CFTRI	32.817	29.980	81.803	15.004	3.988	23.009	186.601	6.068	14.659	—	2.715	23.442	210.043
CDRI	28.310	27.643	76.732	26.527	8.071	39.267	206.550	8.000	7.000	0.500	—	15.500	222.050
CLRI	17.611	20.663	50.450	13.459	1.215	14.500	117.898	3.499	—	—	1.210	4.709	122.607
NBRI	11.258	20.340	43.960	10.000	1.150	13.190	99.898	3.250	—	—	—	3.250	103.148
IICB	6.950	10.273	25.471	4.730	0.628	6.619	54.671	7.000	7.997	0.931	0.807	16.735	71.406
RRL, Jammu	13.880	17.750	42.870	12.500	2.000	26.040	115.040	5.265	1.360	—	0.525	7.150	122.190
CIMAP	4.260	6.400	21.000	9.500	1.660	10.000	52.820	5.250	—	—	—	5.250	58.070
ITRC	6.730	6.720	20.550	6.520	0.639	10.581	51.740	3.496	—	—	—	3.496	55.236
CCMB	1.100	1.100	4.470	2.592	0.188	10.770	20.220	2.500	1.032	—	—	3.532	23.752
Total IV	122.916	140.869	367.306	100.832	19.539	153.976	905.438	44.328	32.048	1.431	5.257	83.064	988.502
V. Information Sciences Group													
INSDOC	10.735	11.785	28.309	13.249	1.268	8.500	73.846	12.500	—	—	0.872	13.372	87.218
PID	10.580	9.460	24.960	11.993	1.869	34.550	93.412	1.280	—	—	—	1.280	94.692
NISTADS	—	—	—	—	—	—	—	—	—	—	—	—	—
Total V	21.315	21.245	53.269	25.242	3.137	43.050	167.258	13.780	—	—	0.872	14.652	181.910
Total Labs/Instts I to V	641.532	709.404	1719.025	479.305	70.746	657.064	4277.076	163.869	142.252	4.084	20.637	330.842	4607.918

PLAN—SUB-HEADWISE BREAK UP OF ACTUAL EXPENDITURE FOR 1982-83

(Rs. in lakhs)

Labs. Instts.	RECURRING							CAPITAL									Gross Total Cols (8+18)
	P1 Pay of Officers	P2-Pay of Estt	P3-Allow-ances	P4-Contin-gencies	P6-Main-tenance	P7-Chem. App & Equipt	Total Rec	P5(1) Works	P5(2) Services	P5(3) App & Equipt	P5(4) (i) Furniture	P5(4) (ii) Lib. Books	P5(4) (iii) Vehicles	P5(4) (iv) W/shop Store	P5(4) (v) Models & Exhi	P5(4) (vi) Misc., if any	Total Capital	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
I. Physical Sciences Group																		
NPL	4.383	2.300	19.920	2.750	—	15.860	45.213	4.226	17.473	63.581	0.975	0.499	—	—	—	—	86.754	131.967
CEERI	6.733	0.977	13.120	—	—	—	20.830	8.041	7.156	53.350	2.236	—	—	—	0.020	—	70.803	91.633
CSIO	5.596	2.380	9.024	—	—	0.950	17.950	9.249	1.351	21.450	1.244	1.729	—	—	—	—	35.023	52.973
NGRI	5.538	2.751	9.911	4.250	—	9.000	31.450	19.126	3.375	20.000	3.502	—	1.143	—	0.004	—	47.150	78.600
NIO	5.870	0.123	8.529	8.288	—	4.710	27.520	9.426	5.417	30.119	1.000	2.500	2.407	—	—	—	50.869	78.389
Total I	28.120	8.531	60.504	15.288	—	30.520	142.963	50.068	34.772	188.500	8.957	4.728	3.550	—	0.024	—	290.599	433.562
II. Biochemical Sciences Group																		
NCL	6.752	4.901	14.539	—	—	11.000	37.192	22.351	9.827	30.382	—	2.000	—	—	—	—	64.560	101.752
CECRI	2.575	1.510	3.914	1.500	—	6.500	15.999	8.591	8.205	28.557	1.499	—	—	—	0.198	—	47.050	63.049
CS&MCRI	2.795	0.710	2.514	4.017	—	7.013	17.049	4.244	4.611	43.772	1.473	—	0.801	—	—	—	54.901	71.950
RRL. Hyd.	5.300	—	17.700	7.100	—	7.500	37.600	20.660	5.244	23.000	3.498	—	3.773	—	—	—	56.175	93.775
RRL. Jorhat	4.220	1.905	9.492	3.368	—	8.998	27.983	17.092	14.996	27.298	1.097	—	0.799	—	0.198	—	61.480	89.463
CFRI	—	—	11.550	1.000	—	—	12.550	12.250	6.446	48.824	1.837	—	—	—	0.415	—	69.772	82.322
IIP	4.714	0.969	10.587	—	—	5.025	21.295	2.317	3.454	20.045	0.687	—	—	—	0.378	—	26.881	48.176
Total II	26.356	9.995	70.296	16.985	—	46.036	169.668	87.505	52.783	221.878	10.091	2.000	5.373	—	1.189	—	380.819	550.487
III. Engineering Sciences Group																		
RRL. Bhopal	—	5.484	—	6.947	0.154	3.392	15.977	—	4.165	52.632	3.000	7.733	—	—	—	—	67.530	83.507
NML	1.807	0.287	4.104	1.000	—	2.995	9.993	1.876	2.778	17.119	1.602	—	2.940	—	—	—	26.315	36.308
CG&CRI	2.265	3.099	5.815	4.000	0.352	6.424	21.955	14.380	1.037	17.983	0.642	—	0.164	—	—	—	34.206	56.161
CMRS	0.003	0.133	14.804	2.079	—	—	17.019	5.143	2.632	15.000	0.108	—	—	—	—	0.100	22.983	40.002
CMERI	3.032	0.910	6.558	—	—	3.000	13.500	6.219	1.996	15.202	0.744	—	—	—	—	—	24.161	37.661
NEERI	4.406	1.305	1.068	6.513	—	3.111	16.403	8.829	2.506	27.953	0.799	—	—	—	0.049	—	40.136	56.539
NAL	7.336	—	5.785	2.876	—	3.034	19.031	13.472	6.932	38.576	1.989	—	—	—	—	38.641	99.610	118.641
NTAFC	0.992	—	1.807	—	—	7.626	10.425	0.319	—	32.893	—	—	—	—	—	—	33.212	43.637
RRL. Bhub.	4.500	—	3.900	—	—	4.500	12.900	10.398	2.056	43.652	0.400	—	—	—	0.048	—	56.554	69.454
SERC(R)	0.103	0.020	1.056	—	—	2.130	3.309	—	0.150	0.837	0.141	—	—	—	—	—	1.128	4.437
SERC(M)	3.285	1.130	3.755	1.619	—	6.911	16.700	—	—	35.000	0.999	—	—	—	0.049	—	36.048	52.748
CSIR Madras Comp.	—	—	—	—	—	—	—	13.360	20.079	0.300	0.400	—	—	—	—	—	39.139	39.139
RRL. Triv.	3.623	5.307	11.585	2.467	—	4.200	27.182	3.250	1.400	30.650	1.000	3.050	—	—	—	—	39.350	66.532
CSIR Cochin Comp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CRRI	2.497	2.836	6.701	2.596	—	3.885	18.515	0.895	1.099	11.910	1.124	—	—	—	—	—	15.028	33.543
CBRI	1.799	—	9.201	1.900	—	0.500	13.400	3.484	0.793	7.223	—	—	—	—	—	—	11.500	24.900
Total III	35.648	20.311	76.139	31.997	0.506	51.708	216.309	86.675	47.623	346.930	12.948	10.783	3.104	—	0.146	38.741	546.900	763.209
IV. Biological Sciences Group																		
CFTRI	4.700	—	3.700	5.000	—	10.000	23.400	11.950	1.958	17.704	1.887	—	—	—	—	—	33.499	56.899
CDRI	4.419	—	1.581	4.000	—	15.000	25.000	10.383	6.005	44.711	1.491	—	—	—	—	—	62.590	87.590
CLRI	0.737	0.426	1.868	—	—	0.745	3.776	16.780	5.505	20.036	1.486	—	—	—	—	—	43.807	47.583
NBRI	3.000	—	3.100	3.240	—	5.310	14.650	11.000	3.872	9.999	2.196	—	—	—	—	—	27.067	41.717
IICB	5.227	1.436	8.424	4.703	—	18.970	38.760	5.578	32.311	29.989	0.647	—	—	—	—	—	68.525	107.285
CFB	1.316	2.848	6.913	5.755	0.475	4.972	22.338	0.653	0.092	7.653	0.207	0.130	—	0.032	—	—	8.767	31.105
RRL. Jammu	5.110	0.264	5.625	3.500	—	11.921	26.420	14.459	8.135	32.117	4.249	—	3.130	—	—	—	62.090	88.510
CIMAP	3.584	3.843	3.964	7.207	—	6.570	25.168	24.981	4.827	40.046	2.576	2.679	0.996	—	—	—	76.105	101.273
ITRC	2.397	1.796	8.192	2.994	—	9.975	25.354	11.850	3.362	17.449	2.437	—	2.364	—	—	—	37.462	62.816
CCMB	4.292	1.608	10.013	6.246	—	11.002	33.161	47.133	158.965	47.812	2.769	3.000	1.350	—	—	—	261.029	294.190
IMT	0.046	0.003	0.129	1.159	—	—	1.337	—	—	1.013	0.801	0.600	—	—	—	7.400	9.814	11.151
Total IV	34.828	12.224	53.568	43.804	0.475	94.465	239.364	154.767	225.032	268.529	20.746	6.409	7.840	0.032	—	7.400	690.755	930.119
V. Information Sciences Group																		
INSDOC	3.959	—	4.791	—	—	10.495	19.245	36.776	58.654	6.685	6.991	10.858	1.757	—	—	—	121.721	140.966
PID	3.205	0.308	4.261	—	—	7.982	15.756	0.206	—	5.500	0.750	2.591	—	—	—	0.700	9.747	25.503
NISTADS	3.500	0.950	5.590	8.249	—	3.751	22.040	—	—	9.512	0.513	1.368	—	—	—	—	11.393	33.433
Total V	10.664	1.258	14.642	8.249	—	22.228	57.041	36.982	58.654	21.697	8.254	14.817	1.757	—	—	0.700	142.861	199.902
Total I-V	135.616	52.319	275.149	116.323	0.981	244.957	825.345	415.947	418.864	1047.534	60.996	38.737	21.624	0.032	1.359	46.841	2051.934	2877.279

LABORATORYWISE DETAILS OF ACTUAL EXPENDITURE FOR 1982-83

(Rs. in lakhs)

Labs. Instts.	RECURRING							CAPITAL										Grand Total Rec + Capital
	P1 Pay of Officers	P2 Pay of Estt	P3 Allowances	P4 Contingencies	P6 Maintenance	P7 Chem., App. Equipt	Total Rec	P5(1) Works	P5(2) Services	P5(3) App & Equipt	P5(4)(i) Furniture	P5(4)(ii) Lib. Books	P5(4)(iii) Vehicles	P5(4)(iv) Workshop Store	P5(4)(v) Models Exhibits	P5(4)(vi) Misc. if any	Total Capital	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
MULTI AGENCY																		
NPL	0.464	0.210	0.724	—	—	—	1.398	—	—	17.949	—	—	—	—	—	—	17.949	19.347
CEERI	—	—	0.281	4.868	—	21.832	26.981	—	—	86.194	—	—	—	—	—	—	86.194	113.175
CSIO	0.998	—	—	—	—	3.447	4.445	—	—	18.994	—	—	—	—	—	—	18.994	23.439
NIO	—	0.938	2.430	5.083	—	9.741	64.151	—	—	61.854	—	0.474	—	—	—	—	62.328	126.479
Boat Optn.						45.959												
NCL	—	—	—	—	—	5.000	5.000	0.822	—	41.617	—	—	—	—	—	—	42.439	47.439
CSMCRI	—	—	—	—	—	—	—	—	—	2.801	—	—	—	—	—	—	2.801	2.801
RRL, Hyd.	7.548	1.125	10.250	7.574	—	3.500	29.997	—	—	25.000	—	—	—	—	—	—	25.000	54.997
RRL, Jor.	—	1.131	—	0.146	—	0.580	1.857	—	—	16.376	—	0.409	—	—	—	—	16.785	18.642
CFRI	—	—	—	—	—	—	—	—	—	8.447	—	—	—	—	—	—	8.447	8.447
IIP	0.172	—	0.214	0.004	—	0.041	0.431	—	—	9.268	—	—	—	—	—	—	9.268	9.699
NML	—	—	—	—	—	—	—	—	—	10.750	—	—	—	—	—	—	10.750	10.750
CGCRI	—	—	—	—	—	—	—	—	—	20.000	—	—	—	—	—	—	20.000	20.000
CMRS	—	—	—	—	—	—	—	—	—	14.279	—	—	—	—	—	—	14.279	14.279
RRL, Bhub.	—	—	0.783	0.469	—	5.526	6.778	7.570	0.250	15.606	—	—	—	—	—	0.076	23.502	30.280
CMERI	—	—	—	—	—	—	—	—	—	6.000	—	—	—	—	—	—	6.000	6.000
Total	9.182	3.404	14.682	18.144	—	95.626	141.038	8.392	0.250	355.135	—	0.883	—	—	—	0.076	364.736	505.774
THRUST AREA																		
NPL	0.668	0.210	1.514	—	—	—	2.392	—	—	8.966	—	—	—	—	—	—	8.966	11.358
NGRI	—	—	—	—	—	—	—	—	—	16.009	—	—	—	—	—	—	16.009	16.009
NIO	1.991	—	1.707	2.092	—	0.046	5.836	—	—	0.209	0.113	1.343	—	—	—	—	1.665	7.501
RRL, Jor.	—	—	—	0.560	0.002	0.367	0.929	8.951	—	4.227	0.162	0.212	0.994	—	—	—	14.546	15.475
CGCRI	—	—	—	—	—	—	—	—	—	20.000	—	--	—	—	—	—	20.000	20.000
CLRI	—	—	—	—	—	—	—	0.964	1.061	21.661	0.834	—	—	—	—	—	24.520	24.520
NBRI	—	0.303	0.849	0.541	—	0.791	2.484	—	—	0.719	—	—	—	—	—	—	0.719	3.203
RRL, Jammu	—	—	—	—	—	—	—	—	—	15.000	—	—	—	—	—	—	15.000	15.000
Total	2.659	0.513	4.070	3.193	0.002	1.204	11.641	9.915	1.061	86.791	1.109	1.555	0.994	—	—	—	101.425	113.066

APPENDIX I

PROCESSES THAT HAVE GONE INTO PRODUCTION (FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party	Nature of Licence
Products of Food Industry Including Beverages			
	CFTRI		
1	Ragi based weaning food	Titan Protein Food Formulations, Mysore	Non-exclusive
2	Cocoa butter from cocoa mass	Mysore Food and Farm Products Pvt. Ltd., Bangalore	Non-exclusive
3	Malted beverage food	Mysore Food and Farm Products Pvt. Ltd., Bangalore	Non-exclusive
4	Mustard powder	Wakefield products Co. (India) Ltd., Pune	Non-exclusive
Chemicals			
	CECRI		
5	Paint stripper	Dasavatar Industry, Trichy	Non-exclusive
	CSMCRI		
6	Zeolite, sodium aluminosilicate for use as detergent	Gabriel Chemicals, Bhavnagar	Exclusive
	RRL-Jorhat		
7	SWAT-104	HICO Products Ltd., Bombay	Non-exclusive
Electrochemicals			
	NAL		
8	Continuous tin/solder plating of copper wires	Reliance Engineers, Bangalore	Exclusive
Drugs & Pharmaceuticals			
	CDRI		
9	L-Ephedrine	Malladi Drugs & Pharmaceuticals Ltd., Madras	Non-exclusive
Pesticides			
	RRL-Jorhat		
10	Phosphomidon	Sudarshan Chemical Industries, Ltd., Pune	Non-exclusive

APPENDIX I

PROCESSES THAT HAVE GONE INTO PRODUCTION—*Contd.*
(FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party	Nature of licence
11	Quinalphos (jointly with RRL-Hyderabad)	Sudarshan Chemical Industries Ltd., Pune	Non-exclusive
	RRL-Hyderabad		
12	Methyl benzimidazole carbamate	J.K. Business Machines Ltd., Calcutta	Non-exclusive
13	Monocrotophos	(1) Sudarshan Chemical Industries Ltd., Pune (2) National Organic Chemical Industries Ltd., Bombay	Non-exclusive
Materials			
	CBRI		
14	Rapid setting lime plaster	Calax Chemicals, Piduguralla (A.P.)	Non-exclusive
15	Skirted granular piles	G.S. Jain & Associates, Roorkee	Non-exclusive
	CGCRI		
16	Cordirite-based saggars	Palam Potteries, New Delhi	Non-exclusive
17	Glass-ceramic tiles for abrasion and corrosion resistance	Garden Reach Ship-builders and Engineers Ltd., Calcutta	Exclusive
18	High temperature protective enamels for jet aero-engines	Hindustan Aeronautics Ltd., Koraput Division, Orissa	Non-exclusive
19	Porous ceramic cups for tensiometer RRL-Hyderabad	Mittal Brothers, Jaipur	Non-exclusive
20	Colloidal graphite SERC-Madras	Industrial Graphite, Hyderabad	Non-exclusive
21	Fibre reinforced concrete light medium and heavy duty manhole covers	R.S. Sangavi, Kirkee, Pune	Non-exclusive
Metallurgy			
	NML		
22	Aluminium based sacrificial anode for cathodic protection	Electro-Protection Services, Madras	Non-exclusive

APPENDIX I

PROCESSES THAT HAVE GONE INTO PRODUCTION—*Contd.*
(FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party	Nature of licence
Machinery			
	RRL-Jammu		
23	Hops dehydrator	J & K State Agro-Industries Development Corporation, Srinagar	Non-exclusive
Electronics			
	CEERI		
24	Electronic process control for sugar industry	(1) Central Electronics Ltd., Sahibabad (2) Satwik Electric Ctrols, Nasik	Non-exclusive
Instruments			
	CBRI		
25	Subsoil deformeter	Associated Instruments Manufacturers India P. Ltd., New Delhi (1) Central Electronics Ltd., Sahibabad	Exclusive

APPENDIX II

PROCESSES RELEASED TO INDUSTRY
(FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party
Products of Food Industry, Including Beverages		
	CFTRI	
1	Ragi based weaning food	Titan Protein Food Formulation, Mysore
2	Wheat milling process for bakery flour and chapati/roti atta	Seven parties
	RRL-Trivandrum	
3	Bottling of coconut water	Jaya Beverages, Nagarcoil
Chemicals		
	CLRI	
4	Waxil emulsions	Shri Dushyant Tyagi, Niwari Dist., Ghaziabad
	CSMCRI	
5	Zeolite sodium aluminosilicate for use as detergent	Gabriel Chemicals, Bhavnagar
6	Control of water pollution of oil using polymeric membranes or absorbents	ONGC, Dehra Dun
	NCL	
7	Hydrogenation of esters from non-edible/edible/acid oils	Aegis Chemical Industries Ltd., Bombay
8	Polycrystalline ultra-pure silicon	Grindwell Norton Ltd., Bangalore
9	Vitamin B6	Lupin Lab. (P) Ltd., Bombay
	RRL-Jammu	
10	Vanillin from sawdust and liquor lignin from paper/pulp industry	Bush Boake Allen (I), Madras
	CECRI	
11	Calcium chromate/iron oxide pigments and paints	Nova Paints, Trichy
12	Chromium flakes and powder electrolytic	(1) Indian Chrome Metals, Rourkela (2) Kishthi Electrolytic Chromium Pvt. Ltd., Hyderabad
13	Paint stripper	Dasavatar Industries, Trichy

PROCESSES RELEASED TO INDUSTRY—*Contd.*
(FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party
Electrochemicals		
	CECRI	
14	Hard anodising of aluminium guide disc used in shock absorbers	Renowned Auto Products and Sachs Ltd., Madras
	NAL	
15	Continuous tin/solder plating of copper wires	Reliance Engineers, Bangalore
Drugs and Pharmaceuticals		
	NCL	
16	Ibuprofen	CIPLA, Bombay
	RRL-Jammu	
17	Gluconate of calcium and iron	Shri R.P. Shukla, Chandigarh
Pesticides		
	RRL-Hyderabad	
18	Monocrotophos 36 WSC formulations	National Insecticides and Chemicals Ltd., Chandigarh
Metallurgy		
	RRL-Bhubaneswar	
19	Enrichment of nickel and cobalt in the overburden of chromite mines	Mineral Development Board, New Delhi
	CMERI	
20	Joining of copper to copper in a recto-former diode bank	Graphite India, Durgapur
Materials		
	CGCRI	
21	Glass enamels/glass colours	S.N. Glass Decorators, Firozabad (UP)
22	Low cost glazed wall tiles	National Ceramics, Hooghly
23	Porous ceramic cups for 'tensiometer'	Mittal Brothers, Jaipur
	CSIO	
24	High strength copper based alloy	Shri Alok Ranjan, New Delhi
	NAL	
25	Foam sandwich FRP shelters	Bharat Electronics Ltd., Ghaziabad

APPENDIX II

PROCESSES RELEASED TO INDUSTRY—*Contd.*
(FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party
	NPL	
26	Carbon bricks, seals and clutch carbons	Siddartha Chemical Products, Baroda
27	Interference filter in wavelength region 0.45 to 1.0 micron	Indian Space Research Organisation, Ahmedabad
28	Micro-carbons-industrial applications	India Carbon Ltd., New Delhi
	SERC, Madras	
29	Fibre reinforced concrete light, medium and heavy duty manhole	R.S. Sangavi, Kirkee, Pune
Machinery		
	CBRI	
30	Charging device for lime kiln	Sona Chemicals, Dehdradun
31	Solar timber seasoning kiln	5 parties
	CFTRI	
32	Pedal operated volumetric filter	3 parties
33	Vegetable slicer	1 party
	CIMAP	
34	Field distillation unit	UP: Gandhi Smarak Nidhi Gandhi Bhavan, Lucknow
	CMERI	
35	Valve and valve sealing of piston type regulator—redesign	Asiatic Engineering Services, Madras
	CMRS	
36	Steel screw prop designs: (a) Rigid type (b) Yielding type (c) Hydraulic device	Eastern Metabright (P) Calcutta
	CRRI	
37	Improved bullock cart	Balamurugan Industries, Ranipet
38	Pavement paint marking machine	Ved Engineering Company, New Delhi
	CSIO	
39	Direct reading mechanical dilatometer	Precision Scientific Equipment Corporation, New Delhi
40	Sampling gun	Surge Associates (P) Ltd., Delhi

APPENDIX II

PROCESSES RELEASED TO INDUSTRY—*Contd.*
(FOR THE FIRST TIME IN 1982-83)

Sl. No.	Process	Party
	RRL-Jammu	
41	Hops dehydrator	J & K State Agro-Industrial Development Corporation Ltd., Srinagar
42	Turpentine fractionating unit-design drawing of	Dujodwala Resins and Turpentine Pvt. Ltd., Jammu
Electronics		
	CEERI	
43	12.5 kW RF induction heater	Berco Welding and Electricals, Jullundur City
44	V.H.F. Multichannel Varicap T.V. tuner	Lt. Col. R. Sarna, New Delhi
Instruments		
	CBRI	
45	Sub-soil deformeter	Associated Instruments Manufacturers India Pvt. Ltd., New Delhi
	CGCRI	
46	Blood capillary *p*H electrode	Sensitive Glass Industries, Gudur
	CSIO	
47	Wide angle optical lens system (1) 210 mm, f/5 (2) 180 mm, f/5	(1) Nagpal Stanley International Hoshiarpur (2) Tosh Optics, Delhi
	NAL	
48	Airborne transducers and associated instrumentation	Aeronautical Research and Development Board, New Delhi
49	DC/AC polarograph	Elico Pvt. Ltd., Hyderabad
50	Sequential temperature programmer	(1) K. Venkatasubramanian, Bangalore (2) System Aids, Lakshmi Puram, Bangalore
Others		
	CFTRI	
51	Shark fin rays	Shri B.M. Zakaria, Bajpe
	CFRI	
52	Chemical demineralisation of coal	Premium Coke Manufacturing Co., Dhanbad

APPENDIX III

CSIR PATENTS FILED, ACCEPTED & SEALED AND UNDER OPPOSITION IN INDIA & ABROAD DURING THE PERIOD 1.4.1982 TO 31.3.1983

Name of the Laboratory	INDIA			ABROAD			Opposition for CSIR	Opposition against CSIR
	Filed	Accepted*	Sealed	Filed	Accepted	Sealed		
CDRI, Lucknow	16	8	—	4	—	1	—	—
NCL, Pune	9	6	6	—	—	—	—	—
CECRI, Karaikudi	9	13	5	—	—	—	—	—
RRL, Bhubaneswar	8	4	1	—	—	—	—	—
IICB, Calcutta	8	—	1	—	—	—	—	—
IIP, Dehradun	4	2	—	—	—	—	—	—
RRL, Hyderabad	4	6	—	10	—	1	—	—
CEERI, Pilani	3	—	—	—	—	—	—	—
CFTRI, Mysore	3	—	—	—	—	—	—	—
CFRI, Dhanbad	3	1	1	—	—	—	—	—
CBRI, Roorkee	2	2	1	—	—	—	—	—
NAL, Bangalore	1	2	—	1	—	—	—	—
CIMAP, Lucknow	1	2	1	—	—	—	—	—
CLRI, Madras	1	2	—	—	—	—	—	—
CMERI, Durgapur	1	1	2	—	—	—	—	—
NPL, New Delhi	1	2	1	—	—	—	—	—
RRL, Trivandrum	1	—	—	—	—	—	—	—
SERC, Roorkee	1	—	—	—	—	—	—	—
SERC, Madras	1	—	1	—	—	—	—	—
CGCRI, Calcutta	—	1	—	—	—	—	—	—
NML, Jamshedpur	—	—	—	—	—	—	—	—
CMRS, Dhanbad	—	2	2	—	—	—	—	—
CRRI, New Delhi	—	—	2	—	—	—	—	—
CSMCRI, Bhavnagar	—	1	—	—	—	—	—	1
NEERI, Nagpur	—	1	1	—	—	—	—	—
RRL, Jorhat	—	2	1	—	—	—	—	1
CSIR, Schemes	1	—	1	—	—	—	—	—
	78	58	27	15	—	2	—	2

Cases before Delhi High Court
1. NPL, New Delhi-1
2. CSMCRI, Bhavnagar-1

Cases before Calcutta High Court
1. CFRI, Dhanbad-1

P.S. Total No. of Cases Received during 1.4.1982 to 31.3.1983:85
*Includes those filed earlier but accepted during 1982-83.

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Date .....
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