ANNUAL REPORT 1983-84



COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH NEW DELHI

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COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

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BASIC DATA

National Laboratories/Institutes	...	39
Industrial Research Associations	...	2
Extension Centres/Field Stations, etc.	...	101
Total staff (1.8.1983)	...	23924
Scientists	...	4662
Supporting scientific staff	...	1199
Supporting technical staff	...	9591
Administrative staff	...	4004
Group D (Technical 2634) (Others 1834)	...	4468
Research Committees	...	15
Research schemes in progress	...	548
Emeritus scientists	...	43
Pool scientists (as on 31.3.1984)	...	465
Research Fellows	...	3577
Processes that have gone into production	...	56
Processes released to industry	...	58
Patents filed	...	68

Budget for 1983-84 (Rs in lakh)

	Sanctioned estimates	Revised estimates	Actuals
Plan	4700.00	5000.000	5019.490
Non-Plan	5835.00	6160.000	6186.088
Total	10535.00	11160.000	11205.578

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)
CSIR Complex, Palampur, HP	(CSIR Comp., Palampur)
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 1983-84 gives in brief the important achievements of national laboratories in such areas as chemicals, energy, machinery development, post-harvest and agro/bio-technologies, etc. A summary of the proceedings of the two meetings of the Society of CSIR held during this period appears at the beginning of the Report. Some highlights of achievements have also been furnished. Details of processes that have been released and have gone into production for the first time can be had from the appendices. Brief notes have been incorporated on significant progress in basic research.

HIGHLIGHTS 1983-84

I Important Achievements

Product	Produced by	Production data	Based on technology developed by
Acrylic acid and acrylates	The Indian Petro-chemicals Corporation Ltd., Vadodara	10,000 tonnes per annum Rs 26 crore capital investment. Annual turnover Rs 32 crore. Largest chemical plant in India now with indigenous technology.	NCL, Pune
Foam sandwich shelters	Bharat Electronics Ltd., Ghaziabad	46 shelters valued at Rs 46 lakh	NAL, Bangalore

NAL completed 10,000 blowdowns in its 1.2 m tunnel, contributing significantly to the design data generation activity for aerospace vehicle development.

NAL continued life evaluation of aircraft. The data generated are useful in deciding the maintenance schedules and providing information to improve the design of aircraft.

NIO completed extensive surveys for identifying two mining sites for polymetallic nodules in the Central Indian Ocean. As a result, India has filed its claims for these mining sites with the Preparatory Commission of the International Sea Bed Authority. This work was also fully supported by the Department of Ocean Development.

II Some Significant Services Rendered

NML successfully demonstrated to the sponsor and the financial institutions the technology for production of electrolytic manganese dioxide with titanium anodes conforming to international specifications. Approaches leading to successful laboratory scale studies had been adopted by NML for recovery of metals of strategic importance from polymetallic sea-nodules.

NML completed the preparation of a detailed project report and tender specifications for process machinery and services, etc. for the 100 tonnes/day graphite beneficiation plant for the Tamil Nadu Minerals Ltd. (TAMIN), Madras.

III Major CSIR-SAIL Projects

(i) *Beneficiation of high silica limestone and dolomite*

The draft status report has been completed by NML on the basis of

information and data received from participating members and is under circulation for obtaining comments for updating the same.

(ii) *Development of direct reduction process using iron ore-coal agglomerates*
High strength briquettes of iron ore and coal using processed tar as binder have been prepared at CFRI for trials at NML's vertical retort furnace (VRF). The trials are to be conducted shortly.

(iii) *Evaluation of the use of pre-reduced iron in LD converter*
Trials at the 130 tonnes converter using sponge iron produced by SAIL (R&D) on the basis of NML technology are continuing.

(iv) *Development of steels for cryogenic applications*
Investigations on development of nickel-vanadium steels are in progress at NML.

Major CSIR-DFVLR Collaboration Programmes

Title of the project	Time schedule	Lead laboratory
Establishment of Calibration Standards for Transonic Turbine Cascade tunnels	1982-86	NAL

IV Major Sponsored Research Programmes

Sl. No.	Title	Sponsored by	Contract value
1.	Aerodynamic investigation of high pressure ratio impellers and their diffusers	ARDB	Rs 26.980 lakh
2.	Design and fabrication of mobile X-ray stress diffractometers	ARDB	Rs 6.500 lakh
3.	Development and installation of the computer programme package for setting up structures	ARDB	Rs 30.00 lakh
4.	Aeroelastic testing of polar satellite launch vehicles	VSSC	Rs 6.30 lakh

Some Abbreviations

SAIL : Steel Authority of India Ltd.
ARDB : Aeronautical Research & Development Board
VSSC : Vikram Sarabhai Space Centre

CSIR Society

Two meetings of the Society of CSIR were held on 13 April 1983 and 18 January 1984. President of CSIR, Smt. Indira Gandhi, presided.

A résumé of the important decisions taken at these meetings is given below:

On 13 April 1983

DGSIR made a statement drawing particular attention to:

(i) the need for the Government to set up machinery to ensure utilization of technologies developed by national laboratories;
(ii) the proposed CSIR-Industry get-together;
(iii) the establishment of the Institute for Microbial Technology; and
(iv) the request made by him to the Chairmen of the Research Advisory Councils for reviewing the ongoing projects and assigning of priorities in national laboratories.

The audited annual accounts of CSIR for the year 1981-82 and the audit report thereon were adopted by the Society.

President, CSIR, in her remarks, stated that guidelines for the implementation of the Technology Policy Statement needed to be issued. She also made a reference to the Karimnagar Project undertaken by the CSIR some time back and felt that such projects could be extended to other areas also. The question was whether, to make up for the lost time, it was necessary to go through all the stages or one could jump over them and not only create technology but also provide the latest technology to the backward areas. Some attempt was being made in Lakshadweep Islands to utilise solar and wind energy, desalination technology and improved techniques for development of fisheries. She was concerned about the lack of coordination between Departments of Government and the municipalities which came in the way of extension of benefits of Science and Technology to the masses. She had directed the Cabinet Secretary to examine how these could be better coordinated. CSIR would have a useful role to play in such efforts, she said. She also referred to the need of linkages and mentioned that SACC is also seized of the matter; such linkages are necessary not only with industry but also with user groups such as farmers and housewives.

On 18 January 1984

Welcoming the members, Shri Shivraj V. Patil, Vice President, CSIR, referred to the progressive reduction in the number of research projects, CSIR's increasing linkages with industry, development of technology for rural areas, criteria for selection of projects, ongoing work on formulation of 7th Five Year Plan of CSIR and complementary-funding from S&T budgets of ministries.

In his report to the Society, DGSIR referred to (i) the year 1984-85 as the year of consolidation, (ii) the derivative content of the 7th Five Year Plan of CSIR, particularly relating to areas such as aeronautics, biotechnology, coal, drugs, electronics, environment, ocean development, non-conventional sources of energy, petroleum, roads and steel, (iii) the possibility of further collaborative programmes with ISRO, HAL, ONGC, BEL & DRDO, (iv) the capability available in CSIR in the areas of Large and Very Large Scale Integrated Circuits, and (v) the need for bringing about institutional

arrangements of integrating the research efforts of CSIR with the programmes of ministries in the light of the decisions taken in the meeting of the Committee of Secretaries (held on 13 December 1983) on a Note on the Better Utilization of CSIR by Public Sector Enterprises.

The Annual Report and the audited annual accounts of CSIR for the year 1982-83 together with the audit report thereon were adopted.

President, CSIR, observed that there was no confusion with regard to the importance of both fundamental research and applied research; there was no dichotomy between the two. Emphasis on either did take into account specific needs and circumstances, but it was necessary to take a total view of science and technology. She had in her speeches elsewhere also mentioned that fundamental research led to discoveries and techniques which were readily applicable or could be applied later effectively. DGSIR had talked about the work of CSIR in the areas of desalination, drinking water, rural sanitation, etc. She appreciated this effort, but emphasised that much more work was required to be done and that not much money was needed for this. She stressed the need for a change in the thinking of scientists, who should apply their minds to the solution of problems leading to the reduction of drudgery, improvement in rural techniques and safety of appliances, etc. Referring to the talks of breakthroughs in science and technology, she stated that no major breakthrough had perhaps taken place in India and underlined the importance of fundamental research.

"We have been talking of breakthroughs but actually we have not made major breakthroughs. In any case what we call breakthroughs were actually made somewhere else earlier."

The President welcomed recent suggestions for better utilisation of CSIR by Ministries, Departments and Public Sector Enterprises. She desired that the identification of the laboratories with the major user ministries should be expedited and that they should be able to work together in a cooperative and not competitive spirit. The President felt that the industry, including the private sector, should sponsor more research programmes in CSIR laboratories. She noted that the Secretaries' meeting had also considered movement and interaction of scientists between CSIR and PSEs and stressed the need for greater movement of research personnel between CSIR and other R&D units in industry and universities.

She agreed that steps be taken to generate more revenue through sponsored research and returns from industry on exploited research and desired that Member (Finance) may evolve appropriate measures. She also stressed the need to identify priority and thrust areas and for greater involvement of younger scientists at higher levels of decision-making. She further stressed the need to create an awareness among scientists and others whereby they could do many things for themselves and for the country in the long run with a little help and guidance, but largely by their own efforts.

RESEARCH UTILISATION AT A GLANCE

During the year, 56 new processes went into production (Appendix I) and 58 new processes were released to the industry (Appendix II). The total number of processes released to industry till the end of the year was 1458; of these, nearly 678 processes were reported to be in production.

Rs. 2500 lakh is the contract value of the 600 sponsored research projects in operation during the year in the CSIR laboratories. Of these 150 projects valued at around Rs. 210 lakh were completed; 440 consultancy projects valued at around Rs. 160 lakh were in hand in the CSIR laboratories. 180 consultancy projects valued at around Rs. 50 lakh were completed.

During the year, 68 patents were filed; 26 patents were accepted and 54 sealed in India (Appendix III); 2 patents were filed abroad. Premia/royalties received for the last three years were as follows:

Year	Premia	Royalties (Rs. in lakh)	Total
1981-82	5.280	75.368	80.648
1982-83	8.280	40.490	48.770
1983-84	8.118	117.670	125.788

THIRD ANTARCTICA EXPEDITION

Base support for the second and third successful Antarctica expeditions was provided by NIO. A biologist of NIO completed winter studies in Antarctica during 1982-83 and is expected to return this year. Another biologist is now wintering at the manned station at Dakshin Gangotri. Four more scientists of NIO participated in the third expedition.

As a result of these successful expeditions, organized in collaboration with the Department of Ocean Development, India was accorded the status of a consultative member of the Antarctica Treaty Organisation in 1983. NPL participated in the third Antarctica expedition also to continue the experiments in radio propagation and studies of the high latitude upper atmosphere. The three major experiments conducted relate to (i) multi-frequency OMEGA reception for studies of the high latitude D-region behaviour during quiet and disturbed periods, (ii) cosmic noise absorption (RIOMETER) on 20 and 30 MHz for studies of auroral zone absorption events, and (iii) ground level micropressure fluctuation recordings, using two microbarographs for studies of acoustic gravity wave induced disturbances. All these experiments were conducted successfully, and data collected for analysis.

CONTRIBUTIONS TOWARDS RURAL DEVELOPMENT AND DEVELOPMENT OF BACKWARD AREAS

A mobile reverse osmosis plant for desalination of brackish water having a capacity of 15,000 litres/day of fresh water was commissioned by CSMCRI. Reverse Osmosis (RO) technique on which the plant is based has been proved to be effective for desalination of brackish water up to 10,000 parts per million (ppm). It would now be possible to treat brackish water for getting potable water in villages where due to salinity ingress groundwater becomes saline. The plant is equipped with automatic control and does not require constant attention. The cost of such a plant is around Rs 1.20 lakh.

The plant was demonstrated in rural areas near Bhavnagar as also in Andhra Pradesh. The governments of Andhra Pradesh, Gujarat and Tamil Nadu have shown keen interest in utilising RO technique for obtaining potable water in rural areas where only brackish water is available.

The plant was also displayed in the exhibition 'Ocean and its resources' held in New Delhi during September 1983.

A solar still plant of 2,000 litres/day of fresh water from sea water based on CSMCRI design was commissioned at Bitra Island. The construction of the plant was carried out by the Central Public Works Department, Union Territory of Lakshadweep. The plant caters to the drinking water need of the island inhabitants. The Institute also commissioned a solar still desalination plant at Narain Sarovar in the Kutch district of Gujarat. The plant provides 2400 litres/day of fresh water by desalinating 13,000 ppm feed water.

NEERI has completed the technological evaluation of Slow Sand Filtration (SSF) under Indian conditions. Four full-scale water treatment plants in different parts of the country were constructed and their performance was evaluated. The SSF process has proved to be an appropriate technology for rural water supply schemes, particularly in tropical climatic conditions as in India. NEERI can now offer a technology package on SSF for rural water supply systems. The study is of significance in the context of the Water Supply and Sanitation Decade Programme (1980-1990) launched in India. The project was undertaken in collaboration with the International Reference Centre for Community Water Supply and Sanitation (IRC), The Netherlands, as part of the global project on integrated research and demonstration project on SSF.

The rural sanitation project of NEERI has entered the ninth year. Todate, over 1400 latrines have been constructed in the ten project villages around Nagpur. The study has revealed the difficulties encountered by rural people in acceptance of the programme and the need for promotion of health education and community participation. The Nagpur Zilla Parishad is collaborating in this project.

With a view to assessing the health impact, NEERI in association with the Department of Health of the Government of Maharashtra, has carried out a parasitological survey of people in ten project villages around Nagpur, where the Rural Sanitation Project is in progress.

Under a sponsored project of the Ministry of Shipping and Transport, CRRI had earlier prepared 10 prototype bullock carts with improved design and innovative features and supplied them to identified farmers in villages in and around Delhi for field trials. During the year, ten more prototype carts were fabricated for trials in Haryana, Himachal Pradesh, Punjab, Rajasthan and Uttar Pradesh. The carts are now with the farmers of these states for field trials.

A Get-together on Choice/Generation/Adaptation/Transfer of Technologies for Rural Development and an S&T exhibition were organised by NISTADS at Bankura, West Bengal during 23-28 December 1983. The objective of the get-together and exhibition was to study and explore the possibilities for improving the existing artisan production techniques for utilising indigenous R&D activities.

Scientists from various laboratories of CSIR and other R&D agencies, artisans of Bankura district and leading members of different government bodies like West Bengal Small Industries Corporation, Small Industries Service Institute, Khadi and Village Industries Commission participated in the programme.

NML scientists actively participated in the get-together and exhibition arranged by NISTADS at Bankura. A theme paper on "the development of rural technologies for metallurgical-based industries in general and for the district of Bankura in particular" was presented.

CLRI has brought about improvement in quality and reduction in processing time besides providing for utilisation of local resources, with the ultimate objective of obtaining better added value for the leather so as to benefit the rural artisans. More than 2000 families of tanners in the rural areas have benefited directly from these demonstrations; the indirect benefits have gone to nearly 10,000 families. The utilisation of bag tanned leathers for preparation of finished leathers used in sports goods manufacture has been successfully demonstrated and taken up by the industry.

RESOURCE DEVELOPMENT—COAL AND OTHER MINERALS

Coal

The results of the analysis of the borehole coal core samples communicated by CFRI to the drilling organisations like the Central Mine Planning and Design Institute Ltd., the Geological Survey of India, Mineral Exploration Corporation Ltd., Singareni Collieries Co. Ltd., etc. have enabled the identification of large seams of metallurgical grade coke. Some of the important seams are: the reserves in Singra Block of Jharia coalfield; over 100 million tonnes of medium to prime coking coal reserves in Baherband Jalsor Sector of Sohagpur coalfield (Madhya Pradesh), nine workable coal horizons in Birbhum District (West Bengal) and eleven coal horizons in the south eastern part of Raniganj coalfield.

In the wake of the successful trials conducted by CFRI in the low shaft blast furnace of M/s Kalinga Iron Works at Barbil, Orissa, in December 1982, it has been recommended that a 500 tpd formed coke plant be set up at the Kalinga Iron Works to produce low phosphorus formed coke from non-caking coals.

CFRI has undertaken studies and made recommendations to the Indian Iron and Steel Co. Ltd. (IISCO), Burnpur, on selection of optimum coking blends. The recommendations are being considered for adoption by IISCO.

The investigation on the coking potentialities of the Bermo seam coal of Bermo colliery in East Bokaro coalfield, sponsored by Damodar Valley Corporation, has been completed. The CFRI study has revealed that this coal after washing can be classified as medium coking coal for production of metallurgical coke and should not be used for thermal power generation.

CFRI has developed a method for the determination of coke strength in a fractional Micum drum which requires half the quantity of the sample for carrying out tests needed in the standard test method. Adoption of this method will result in cutting down the cost of coke testing, including the labour, apart from saving of time in conducting the test. A proposal for adopting this as a standard method in place of the existing one has been submitted to the Indian Standards Institution.

Following requests from the Royal Government of Bhutan (received through the Ministry of External Affairs, Government of India and CSIR), CFRI has taken up a project on utilization potentialities of Bhutan coal. It has been proposed to execute the project in two phases. Three bulk samples (3 tonnes each) and 16 channel samples of coal were collected by CFRI scientists from the working mines at Samarag and from Shangtar and Dewathang areas. Information on the geology and occurrence of the coal reserves in Bhutan has also been collected.

At the request of the National Thermal Power Corporation Ltd., New Delhi, CFRI has studied the problems of spontaneous combustion and prevention of fire hazards in coal stacks *vis-à-vis* stacking and safe storage of coal at the super-thermal power station at Saktinagar, Singrauli. The infield studies have been completed and a report on CFRI's concept of combating

spontaneous combustion has been submitted. It has been demonstrated that the low-rank sub-bituminous type of coal linked to the power station can be safely stored for 3-4 weeks.

The extraction of all the three workable sections of seam I at Talcher colliery of the Central Coalfields Ltd. (CCL) has posed difficult strata control and operational problems due to the existence of full height development of the bottom section, variable thickness of the immediate partings and incompetent basal Barakar formation. A method called 'fenderless method of mining' has been developed at CMRS on the basis of model observations. It reveals that the top section can be worked as an independent seam even in the presence of developed pillars of the bottom sections. The bottom section can thereafter be extracted to 90-95 per cent in conjunction with stowing. Tight stowing and full recovery of this section is likely to cause least disturbance to the middle section, which is likely to consolidate further with time due to argillaceous content of the formation. The scheme is under implementation at Talcher.

The management of the Eklehra colliery desired to extract the maximum percentage of coal from the locked-up pillars in NEL district of No. II seam below a village without causing any damage to the structures. CMRS undertook the study to estimate the optimum size of stocks to be left *in situ* during final operation and achieve the maximum percentage of extraction. The study indicated that it was possible to extract 68.2 per cent of coal from the locked-up pillars below surface structure without causing any damage by adopting splitting as the final operation. The anticipated quantity of coal which could be extracted by splitting the pillars in the district would be approximately 45,000 tonnes.

CMRS undertook a project to put the non-working borehole stowing plan which could not be operated for a long time because of pipe jams in XI and XII seams of Bhulanbararee colliery of Bharat Coking Coal Ltd. After investigations, some modifications were suggested. It has enabled resumption of stowing operation in the non-working plant and stowing has been conducted with a rate of more than 100 t/h without pipe jams.

Influence of heavy blasting in Nakoda open cast mine on the structure of the Associated Cement Co. plant was investigated by CMRS and optimum charge of blasting for the protection of the structures of the plant was recommended.

Technical assistance was also rendered by CMRS to the management of Bararee fire project for carrying out safe and efficient deep hole blasting in the fire area of open-cast mine.

Other minerals

In collaboration with the Department of Ocean Development, NIO continued its surveys for polymetallic nodules in the Central Indian Ocean. Besides NIO (lead agency) over 25 organisations participated in the ship board work and



ORV Sagar Kanya of the Department of Ocean Development, entrusted to the National Institute of Oceanography, Goa

subsequent laboratory analyses. Besides ORV SAGAR KANYA, two chartered vessels, MV FARNELIA (U.K.) and MV SKANDI SURVEYOR (Norway), completed 7 and 6 cruises respectively of 45 days duration each. The vessels covered more than 0.7 million sq km area, collected more than 100,000 line km of underway data and carried out 3463 sampling operations. Over 11 tonnes of bulk samples were collected and token samples of nickel, copper and cobalt extracted. Based on these detailed surveys and laboratory studies, the Pioneer Area of 300,000 sq km was demarcated and the coordinates provided to the Government of India for filing a claim with the United Nations.

Glass and ceramics

CGCRI has developed community filter candles having rate of filtration of 6-8 litres per hour. Both domestic and community type filter candles have passed bacteriological tests.

Groundwater exploration and management

Resource estimation and water balance studies by NGRI in the arid drought prone region of Maruvanka Basin area in Anantapur Dist. (A.P.) revealed that the draft existing in the basin area is of the order of 60 MCM against an annual

rechargeable potential of the order of 90 MCM, with an estimated total reserve of the order of 190 MCM.

A preliminary study of the mid-Pennar region of Cuddapah Basin indicates that alluvial/colluvial deposits in the main Pennar river and its major tributaries hold substantially good ground water potential. Granular deposits with thicknesses varying between 40 m and 80 m exist in these alluvial areas. Heavy duty wells of one cusec and one-and-a-half cusec capacities could be constructed.

Hydrological investigations of NGRI for the Usar Land Development Project in Aligarh District indicate that the area is suitable for groundwater development through medium and heavy duty tubewells with a yield capacity of the order of 30,000 gallons per hour. The ground water quality in the project area is excellently suitable for both irrigation and drinking.

To assess the groundwater resources of Pondicherry and its environs, environmental tritium and radio-carbon studies were undertaken by NGRI. Preliminary study of the groundwater ages indicates that apart from alluvial deposits, Cuddalore and Vanur sandstones have good recharge conditions, whereas Ottai claystone has limited resource. Based on hydrograph analysis, physiography and various other factors, it has been possible to demarcate different zones representing varying degrees of recharge/exploitation in Pondicherry and to further delineate the zone where the possibility of seawater intrusion exists. Recommendations to avoid such a phenomenon have been made to the Government of Pondicherry.

ELECTRONICS AND INSTRUMENTATION

Electronic devices

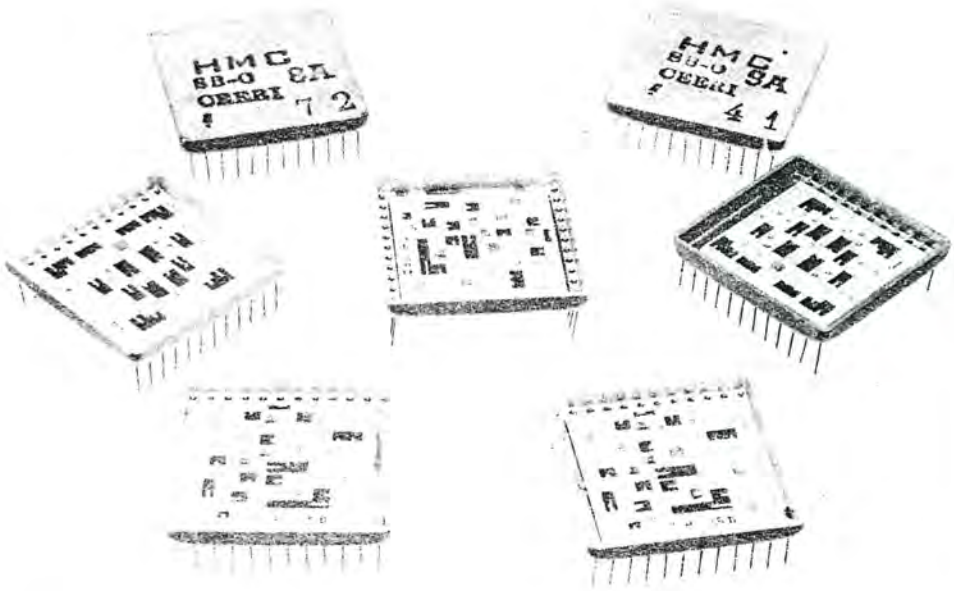
CEERI has developed the capability for batch production of space-qualified single layer thick film hybrid micro-circuits. These circuits have been supplied to the Indian Space Research Organisation (ISRO), Bangalore.

In the joint R&D programme between CEERI and Bharat Heavy Electricals Ltd. (BHEL), Hyderabad, a three-phase 40 kVA inverter for mining locomotives has been developed by CEERI. This is being tested in the field.

Electronic systems

CEERI scientists have, at Bradford, UK, successfully developed a pulse width modulation (PWM) logic system for the microprocessor-based PWM solid state A.C. drive for electric vehicles, as a part of the joint R&D project between CEERI and the University of Bradford, UK, under a memorandum of understanding between the British Council and CSIR.

Know-how for a 32 line microprocessor-based electronic telephone exchange was passed on by CEERI to (i) M/s Power Electronics and Controls, Vadodara, and (ii) Bihar State Electronics Development Corporation, Patna, through NRDC. M/s Power Electronics and Controls, Vadodara, have gone into production. Know-how on thick film circuits for industrial use is ready for transfer. Negotiations with one firm have been completed.



Space-qualified hybrid micro-circuits developed by the Central Electronics Engineering Research Institute, Pilani

Space-qualified interference filters developed by NPL for the infrared band Smart Sensor (Payload of Rohini Satellite D-2) performed extremely well throughout the mission life of the satellite, as per reports of ISRO.

Instrumentation

The design and development of a laboratory prototype of Methane Gas Interferometer has been completed by CSIO in consultation with CMRS.

Electronic process control instruments and control systems for sugar industry, such as automatic *p*H control and panometer manufactured by two licensed firms based on CEERI know-how have been installed in more than 30 sugar factories resulting in an increase in production of sugar. More sugar factories have shown interest in procuring these instruments from CEERI collaborators.

A prototype of a microprocessor-based rotor current meter was developed and successfully demonstrated by NIO (reported last year). The Hydrographic Department of Calcutta Port Trust has sponsored a project for the fabrication of six prototypes of such current meters.

NAL established a low speed wind tunnel for active control flow facility. It is an open circuit low speed tunnel capable of testing at velocities up to 45 m/sec in its square test section of 1.5 sq m area. The facility was designed and realised as per design in a short period of 8 months. This will be used for conducting active control experiments on aircraft models. Unlike in a conventional wind tunnel where the flight vehicle model is rigidly fixed, in the present facility, the model is allowed to fly in a limited degree-of-freedom suspension. This enables a more realistic picture of the dynamic situation.

The compensated ultrasonic timer technique of NGRI (reported last year) has been improved with regard to its accuracy by about 100 times, thus enabling the measurement of transit time to the nearest 0.001 microsecond at different P-T conditions allowing its wider use and applicability.

CHEMICALS

Drugs and pharmaceuticals, pesticides and other chemicals

Bengal Immunity Company Limited (BICL), a Government of India undertaking, developed a process for the antimalarial drug chloroquine phosphate in 1954 and a 4 tpa plant was later commissioned at Calcutta. In 1979, BICL approached RRL, Jorhat to restandardize the process conditions and optimize the process steps. The restandardized process was scaled up in the BICL 4 tpa plant. RRL, Jorhat also provided the basic designs for a 80 tpa plant, proposed to be set up by BICL.

Production of *Bacillus thuringiensis* was continued and 12 kg of water dispersible spore powder and 365 g of spore crystal complex were supplied by CDRI to Vector Control Research Centre, Pondicherry, for field trials as a mosquito larvicide.

NCL developed a modified process for the isolation of vinblastine. M/s CIPLA, a pharmaceutical firm of Bombay, have commenced bulk commercial production of this anti-cancer drug.

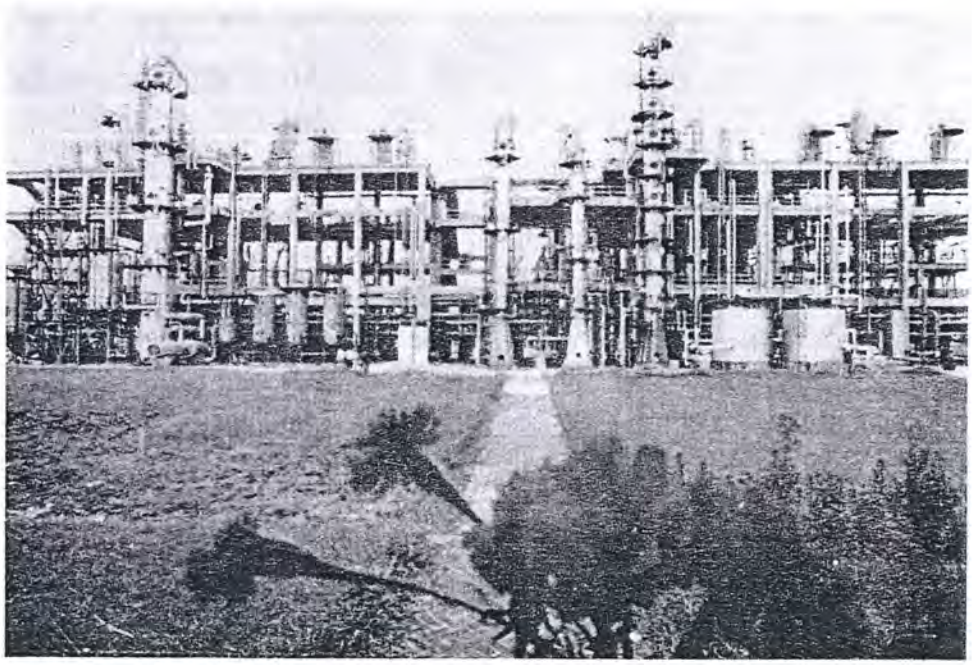
M/s TTK Pharma Private Limited, Madras, have launched a new product—Flematic skin oil—based on the technology developed under the advice of NCL. This is used for a variety of skin diseases of domestic animals.

M/s Chintamani Fine Chemicals, Pune, have commenced commercial production of Quinapyramine sulphate and chloride (QSC) based on the technology developed by NCL. QSC is a drug of choice in the treatment of Trypanosomiasis (commonly called 'SARA'), a dangerous and often fatal disease of domestic animals like cows, buffaloes, horses, camels, etc. caused by *Trypanosoma evansi*. The NCL product meets the standards prescribed by the British Veterinary Code and matches with the drug presently imported under the trade name Antrycide Prosalt used in treatment of SARA. The estimated requirement of this drug is 3-5 tonnes a year and would be met by indigenous production.

In collaboration with the Drug Standardization Research Unit of the Central Council of Research in Unani Medicine (CCRUM), standardization of the following compound Unani drugs was carried out by NBRI: Jwarish Zarooni, Jwarish Safarjali, Khamira Khas Khas, Hab-e-Ayarij, Sharbat Banafsha, Sharbat Nilofar, Sharbat Unnab, Sharbat Toot Siyah, Khamira Banafsha, Majoon Hajrul-yahood, Jwarish Podina and Jwarish Bisbasa.

In the Central Herbal Drugs Garden located at the Banthra Research Station of NBRI, field scale cultivation of *Ammi majus* (Atrifal), *Punica granatum* (Gulnar farsi), *Psoralea corylifolia* (Babchi) and *Operculina turpethum* (Turbud) was undertaken to help import substitution and to provide authentic drugs for use by the CCRUM pharmacies.

The CFTRI process for *n*-triacontanol, a plant growth regulator isolated from tea wastes, has taken off as a commercial venture. The chemical is being manufactured by M/s Greenex Chemicals (Pvt.) Ltd., at their factory recently



Acrylates plant of Indian Petrochemicals Corporation Ltd, (IPCL), Vadodara, based on know-how developed by the National Chemical Laboratory, Pune

set up at Siliguri in West Bengal under a technical consultancy arrangement with CFTRI. Foliar spraying of this chemical in milligram quantities increases the yield of tea leaves by 25-40%. Extensive trials had been carried out earlier by the United Planters' Association of South India (UPASI) and in tea estates of North East India, to prove the effectiveness of this chemical as a plant growth regulator.

Acrylic esters find extensive use in the manufacture of acrylic fibres, paint, paper and allied industries.

The Indian Petrochemicals Corporation Ltd. (IPCL), Vadodara, have put up a 10,000 TPA capacity plant for production of these acrylates based on technology developed by NCL.

The capital investment on the integrated acrylates plant is Rs 26 crore and the annual turnover is expected to be around Rs 32 crore. The quality of the products and the raw material consumption are comparable to international norms.

The technology for the manufacture of phosgene in a continuous process at a scale of 120 kg/day has been developed by RRL-H and successfully demonstrated to the collaborators, M/s Hindustan Organic Chemicals Ltd., Rasayani, Maharashtra, for a period of 72 hours as stipulated in the

agreement. The product phosgene after condensation and vapourisation, has a purity of 99.7% and meets international specifications.

M/s United Catalysts of India Ltd. have produced the catalyst developed by RRL-H for hydrogenation of benzene to cyclohexane. The catalyst will now be used by the Gujarat State Fertilizer Corporation in their commercial plant replacing an imported commercial catalyst.

A process for the production of epoxy resins from Carbanol-bisphenol was developed by RRL-H on sponsorship basis and demonstrated to the sponsor, M/s Synthchem Industries Ltd., Haryana. This type of epoxy resin is the first of its kind to be developed in the country.

A novel single-step industrial process for propionic acid involving direct carbonylation of ethanol has been successfully developed by NCL on sponsored basis on behalf of M/s Deccan Sugar Institute, Pune.

Detailed investigations have been carried out on chromite ore samples to assess their amenability towards beneficiation for a desired grade product. These studies by RRL (Bhu.) included mineralogical and chemical analysis and sink-float studies on closed size fractions of products with different mesh of grind. It is found from the above tests that these samples could be beneficiated to the maximum grade of 60 per cent Cr 203 with a recovery of more than 90 per cent in the concentrate. The final report has been submitted to M/s Mishrilal Mines (P) Ltd., Chaibasa, Bihar, the sponsor of this project.

M/s Industrial Promotion and Investment Corporation of Orissa Ltd. (IPICOL), Bhubaneswar, sponsored the project on 'Development of a process for the production of 16-DPA from solasodine on laboratory scale'. The investigations have been successfully completed by RRL (Bhu.). This is an improvement over known methods of conversion. The economics of a plant with a capacity of production of 600 kg of 16-DPA per year were computed and found to be very attractive.

On 18 September 1983, a 20 TPD tiny cement plant, commissioned by M/s Bharat Cement Industries at Vatva, Ahmedabad was inaugurated. The plant involving an investment of Rs 50 lakh has been set up in a record time of 4 months. RRL, Jorhat assisted the engineers of the firm in successfully commissioning the plant. This is the second mini-cement plant based on vertical shaft kiln technology developed by RRL, Jorhat and commissioned in Gujarat. M/s Kutch Cement (P) Ltd. have been in production since 1981.

Strobel Industries, Nizamabad, Andhra Pradesh, has started commercial production of Carbonless Copying Paper (CCP) and will become the first commercial firm producing CCP, based on indigenous technology. RRL, Jorhat released the process on laboratory scale in the year 1983.

Filter papers making use of cotton and rayon grade pulps have been prepared on laboratory scale and samples of these were sent to M/s Polymer Papers Ltd., Faridabad, by RRL-H of their evaluation. Two grades of these

papers were found comparable to imported papers. Impregnation of some of these sheets with CNSL and phenol formaldehyde resins was also carried out to improve their mechanical strength.

Metals and metal-forming techniques

The following processes for the development of inhibitors and treatment for cleaning and re-passivation of metal surfaces have been developed by NML. Action is underway for assignment to NRDC/CSIR and commercialisation:

(a) Pickling inhibitor for continuous pickling line.
(b) Non-corrosive flux for soldering of copper and copper alloys.
(c) Process for removal of tarnished film from silver and copper surface.

Calcium silicide (CaSi) is extensively used as deoxidiser and desulphuriser in various grades of steels. Besides, one of the important uses of CaSi is for the production of Meehanite cast iron in the production of grey iron castings. The requirement of CaSi had all along been met by imports from Japan, France and other countries.

With a view to utilising the indigenous resources for production of CaSi and also to evaluate their raw materials, M/s Ispat Projects Ltd., Calcutta, sponsored a smelting campaign in NML's pilot 500 kVA submerged arc furnace.

A three week continuous testing campaign had recently been successfully completed wherein both ferrosilicon and CaSi of the desired grade were produced. The test results will enable the sponsor to instal a 5 MVA furnace in which 600 tonnes of ferrosilicon and 1600 tonnes of CaSi may be produced.

A 40 mm diameter deep fluidized bed column was operated by RRL (Bhubaneswar) successfully for the recovery of metal values like Ni, Cu and Zn from synthetic waste solutions. Work was continued for the recovery and removal of a toxic metal like lead from synthetic effluents. Based on the data generated from 40 mm dia column, a 100 mm diameter system was designed and fabricated. Reports were prepared and submitted to EIL on design and development of continuous deep fluidized bed ion exchange system for recovery of metals from effluents.

A 50 tonnes per day sintering plant for manganese ore fines based on the RRL (Bhubaneswar) process, design and engineering know-how has been installed by M/s FACOR, Shreeramnagar, Andhra Pradesh. The plant is producing good quality sinters for over a year now. The plant is at present utilising waste ore fines with a saving of around 60 lakhs of rupees per year besides other benefits derived due to the use of manganese ore sinter in the smelting furnace.

A novel salt roasting process on a 50 kg per batch scale has been developed by RRL (Bhubaneswar) for the extraction of vanadium from vanadium-bearing titaniferous magnetite ores using solid fuel wastes. Encouraging results

have been achieved and recovery of more than 90 per cent of vanadium pentoxide from its ore has been established. An agreement has been executed between the laboratory and IDC, Orissa, for setting up a pilot plant for treating 20 TPD (of charge) to recover vanadium pentoxide from the ore and to study the techno-economic viability of the process.

Studies on a pilot plant operated under a jointly sponsored scheme by CECRI and Tamil Nadu Government for producing magnesium metal by electrolytic route have been completed. The pilot plant has so far produced Rs 30 lakh worth of magnesium and sold it to indigenous consumers. Use of 8 kA capacity modular cells has brought down the energy consumption to 15-16 kWh/kg of magnesium metal as compared to 22-24 kWh/kg in the old design. The licensee, M/s TIDCO, will be setting up shortly a commercial plant of 600 TPA using sea bitterns as raw material.

Efforts at RRL, Bhopal on upscaling the process of making Al-graphite composites in 30 kg heat have been encouraging. Simultaneously, two routes, viz. rapid solidification processing and powder metallurgy technique, are also being investigated.

Chemical engineering, process design

Under PPDC programme of work, dewaxing studies on Haldia Lube raffinates are in progress at IIP with a view to increasing the operational efficiency and maximising the capacity of the Lube Block of the refinery.

Sponsored studies from Assam Oil Division (IOC) were completed by IIP on the feasibility of producing additional paraffin wax and microcrystalline wax from Assam Crude Mix. It was found that from the feedstock (DAO), microcrystalline waxes of medium hard consistency are obtained which do not match the grades currently used in India. From other feedstock (HWD), flexible microcrystalline waxes of type B could be made (yield 0.83%); these are currently being imported.

Feasibility study for the production of oxo-alcohols from refinery FCC off-gases was done by IIP for UP Government. The study covered separation of C_3 and C_4 olefins, oxo-alcohol technologies and profitability analysis.

For Indian Oil Corporation, feasibility of producing benzene, toluene and xylenes (BTX) in the catalytic reforming unit of Haldia refinery was assessed by IIP. The BTX yield estimates were computed on the basis of component analysis of light Arabian and Lavan naphthas obtained from Haldia refinery.

In collaboration with EIL, studies have been taken up at IIP to develop indigenous process and engineering capability on propane deasphalting process. Deasphalting runs on three residues (Kirkuk Short, Arabian mix and Kirkuk blended) were made. For completing some related aspects of IIP-EIL Sulpholane process, studies were done on dearomatized raffinate produced in aromatic extraction units to assess its suitability as a feedstock for fertilizers.

Computer modelling and simulation studies were undertaken by NCL for a number of industrial organisations. These included modelling of chlorobenzene reactor and distillation system (Hindustan Organic Chemicals Ltd., Rasayani); heat exchanger network analysis (Sudarshan Chemical Industries Ltd., Pune); polyethylene terephthalate reactor and spinning simulation (Indian Oil Corporation, Madras, Petrofils Cooperative Ltd., Baroda and Swadeshi Polytex, Ghaziabad). All such simulation efforts have already led or are likely to lead to benefits in terms of productivity and product quality improvement.

A pilot plant facility for studying both basic and engineering aspects of pipeline transportation of coal and other minerals has been set up by RRL (Bhubaneswar) in collaboration with M/s Engineers India Ltd. This is a unique facility of its kind in the country. At present various problems with regard to transportation of minerals and tailings are being studied in this set-up.

POST-HARVEST AND OTHER AGRO/BIO-TECHNOLOGIES

Post-harvest technologies

A new technique of pressure parboiling of paddy has been successfully demonstrated by CFTRI in Khanna, Punjab, with the cooperation of the Food Corporation of India (FCI). The technique essentially consists in wetting of paddy followed by steaming at about 15 lb/sq cm. It saves time and cost besides giving a turnover that is better than that obtained by traditional techniques.

The CFTRI process for baker's yeast was demonstrated (using the 3000 litre fermenter of CFTRI) to M/s Larsen and Toubro, who have entered into a secrecy agreement with NRDC for offering a 750 tonnes/year plant to Bangladesh. Detailed technical reports for plants of 450 and 750 tonnes/year capacities were prepared and furnished.

CFTRI has provided expert help to set up a modern plant at Abohar in Punjab for processing 10 thousand tonnes of Malta oranges and 5 thousand tonnes of tomato a year for AGRIVOLT, a joint venture of Voltas Ltd., and Punjab Agro Industries Corporation. The plant, installed at a cost of about Rs 20 million, has started trial production. A variety of orange and tomato products, including cold pressed orange peel oil, are to be produced and marketed. CFTRI's assistance involved preparation of the project report, selection of machinery, technology and personnel, as well as product evaluation and storage studies.

CFTRI has developed a new spray-dried milk food for infants and released its know-how to Dalmia Dairy Industry Research Institute, Bharatpur, Rajasthan, for commercial utilisation. The level of protein and essential fatty acids of the product, when reconstituted in water, is approximately similar to that of breast milk. The product output is higher than that obtained using commercial formulae. The product was prepared during demonstration to the party. A report providing information on the process of manufacture, along with material balance and cost data was also furnished to the party.

A small scale commercial unit for the manufacture of cocoa mass, cocoa butter and cocoa powder, based on CFTRI know-how, has been set up by a firm—Coffee Lands, Sakleshpur—in Karnataka with a capital investment of Rs 500,000. The unit, commissioned recently, has a capacity to process 150 kilograms of cocoa beans per shift of 8 hours.

Most of the items of equipment are available indigenously, and some of them have been modified to meet specific requirements.

The standardization of raw material quality and process parameters ensures high quality of the products that meet the standards of the users. The products can be used in chocolates, cakes, icing and beverages.

Soyabean contains about 38% protein and 18% oil, but it cannot be directly used as pulse because of beany flavour, bitter taste and poor cooking qualities. R&D work at CFTRI has shown that suitable processing by way of flaking and

toasting at optimal moisture levels as also fermentation can make the soyabean acceptable for use in our dietaries. Processes for dehulling soyabean and production of full-fat/low-fat soy flours have been developed.

Dewaxing of rice bran oil by using an aqueous surfactant solution (earlier worked out at laboratory level) was tested by CFTRI with 20 kg batches obtaining 85% of clean oil; the wax content was reduced from 3.7% to 0.3%. A concentrate containing 80-90% oryzanol could be prepared from the oil/soap stock by adsorption on alumina and re-extraction of oryzanol using a polar solvent.

Apple pomace, a waste product of apple juice industry, poses a pollution hazard and no suitable method for its disposal is available. At the request of the government of J&K, work on its utilisation was carried out by RRL, Jammu. It has been established that the waste product can be utilised for production of vinegar, pectolytic enzyme and in animal feed supplement.

Agrotechnologies

Aroma varieties of hops have been developed by the Branch Laboratory, Srinagar, and released to farmers. M/s Mohan Goldwater Breweries have taken the responsibility for extension work. M/s Mohan Goldwater Breweries are also going in for production of hops oil and hops extract. Design engineering services have been provided by RRL, Jammu.

RRL, Jorhat distributed seedlings of improved variety of *Java citronella* to the growers of Pengeri area of Upper Assam. The village Pengeri has derived its



Villagers engaged in Citronella cultivation at Pengeri (Assam) under the supervision of the Regional Research Laboratory, Jorhat

prosperity by taking to citronella industry on a very large scale. In 1983, 712 growers brought about 1350 hectares of land under citronella cultivation. The villagers produced about 60,000 tonnes of citronella grass valued at Rs 2.7 crore. In this area, there are 59 distillation units of capacity ranging from 50 kg to 2000 kg per batch. The total yield of oil comes to about 6,00,000 kg valued at Rs 5.2 crore. It is worth while to mention that the Pengeri area is surrounded by thick forest and the villagers cannot cultivate paddy or sugarcane due to depredations by elephants. Citronella is not eaten by the elephants; therefore, the villagers can safely cultivate citronella for their sustenance.

The hybridization work carried out at NBRI involving Gladiolus cultivar 'Friendship' (2n-60) × Gladiolus trists (2n-30) resulted in the evolution of a large number of hybrids. Three promising cultivars, Manhar, Manisha and Mohini were released for cultivation in Indo-Gangetic plains.

Sewage grown spirulina was used by NBRI as a substitute for groundnut cake in feed for white Leghorn chicks. The control ration, based on groundnut cake, contained the following ingredients, in g% of diet: yellow maize 40.0; rice bran 19.0; molasses 4.5; groundnut cake 24.0; meat and bone meal 10.0; vitamin and salt mixture 2.5.

In experimental isonitrogenous diets, increasing amounts of spirulina, at levels of 5.6, 11.1 and 16.6% were added to the control ration while replacing the groundnut cake portion. Dry spirulina (16.66%) completely replaced the groundnut protein in the feed. There was no mortality in any of the batches and no abnormalities were noted in the experimental chicks, indicating that spirulina produced in sewage system is non-toxic.

Cutch extract has been successfully used by CLRI as a replacement for the imported wattle extract. This has been tried in sole leather tanning and thanks to the demonstrations carried out by the Kanpur Centre of CLRI, several tanners have turned to the use of cutch as replacement for wattle in their regular production of sole leather for domestic use.

A technique has been developed by CSMCRI for cultivation of Entermorpha seaweed which is known to exhibit antibacterial activity. An yield of 1.9 mt dry alga/yr/ha has been obtained when it was cultivated on nets in the coast at Okha Field Station (Gujarat) of CSMCRI. When the same alga was cultivated in artificial ponds on land an yield of 6-8 mt dry alga/yr/ha was obtained. This technique is ready for exploitation.

The new high yielding strain of Japanese mint, developed by CIMAP last year, was released to a limited number of farmers for commercial cultivation after successful trials at two locations. The release of this variety would make mint cultivation more profitable both for growers and producers of menthol.

Three strains of opium, namely IS-18, IS-34 and GS-24, which were displayed last year in a demonstration (bench-scale) trial at the institute

research farm, have now been graduated to 'minikit trials' (pilot scale testing) in the farmer's field. Thirty farmers scattered over 13 villages in Bara Banki district were supplied with seeds of the above three strains. Based on farmers' choice, two strains, i.e. IS-34 and GS-24, christened 'shyama' and 'sweta', respectively, are being released for commercial cultivation.

The semi-commercial scale pilot plant for rose oil extraction of capacity 125 kg flowers per batch, set up at Hasayan village in district Aligarh, was formally taken over from CIMAP by M/s Agra Mandal Vikas Nigam Ltd. for commercial operation. Under the agreement for technology transfer, CIMAP will continue to provide expertise and technical guidance to the client for efficient running of the plant. The party has plans to expand the capacity. This has generated a lot of enthusiasm among the rose cultivators and the area under rose crop is being increased rapidly.

The pilot plant for production of rose oil set up by CIMAP at Hasayan, district Aligarh, was successfully modified for the distillation of vetiver roots which are available widely in the area. Commercial scale distillation of vetiver in the plant was started by M/s Agra Mandal Vikas Nigam Ltd. Vetiver oil of high quality is being produced in the plant in yield which is much higher than that obtained from country-type distillation units. Production of vetiver oil during the winter months from December to March, when no rose flowers are available, will keep the rose oil plant profitably occupied and enhance its economic viability.

In vitro multiplication and regeneration of shoots of *Albizzia odoratissima*, a shade tree in tea plantations, has been standardized by TESTRA.

Trials of the modified 45 cm B.C.R. for the first roll have been completed by TESTRA and its drawing prepared and passed over to manufacturers for commercialisation.

In order to find out the optimum condition of N, P and K for maximising the yield of mature tea in North East India, various experiments were conducted by TESTRA. The important point that emerged from the results of these experiments was that requirement of phosphate was necessary every year at all the sites along with N and K.

Biotechnology

The development by NCL of a process for obtaining virus-free sugarcane CO 740 through tissue culture technique has now been undergoing extensive field trials over 200 acres of planting in collaboration with Maharashtra State Farming Corporation. These field trials will further be extended to 1000 acres of planting subsequently. Preliminary trials in smaller plantings have indicated cane yield increases of 15-20% over the observed average from the conventionally available stock.

Energy

The 1 tonne/hour moving bed pressure gasification pilot plant of RRL-H was commissioned in the first week of December 1983. This pilot plant will be used for R&D work on gasification of coal with oxygen-steam and air-steam with a view to getting energy for a number of purposes, viz. industrial fuel gas, synthesis gas and low Btu gas for combined cycle power. UNDP assistance to the extent of about $ 1.10 million has been obtained for getting sophisticated instruments like mass spectrometer for gas analysis, coupled to a computer which can also record other process data, indicating gas analysers, thermogravimetric analysis apparatus and a catalyst screening unit. The pilot plant was operated with Ramagundam coal from Andhra Pradesh at 24 bar and 90-95% of rated capacity with oxygen-steam and at 15 bar with air-steam. Association of other organizations like BHEL, PDIL in the further programme of R&D work is envisaged. Work on modelling of the gasifier has also been taken up.

The CFRI process on 'Manufacture of weather resistant smokeless hard and moulded fuels from coke breeze for domestic and/or industrial purposes' has been released by NRDC to three entrepreneurs, namely (i) M/s Modi Fuels, Bokaro, (ii) M/s Drolia Fuels, Ranchi and (iii) M/s Pandey Jet Coke (P) Ltd., Hazaribagh, all in Bihar. The capacity of each plant as proposed is 40 tonnes/day.

The CFRI process for the manufacture of building bricks from flyash, a waste material from p.f. fired power stations has been licensed to three firms by NRDC, namely (i) M/s Jagadhari Brick Industries, (ii) M/s Jyoti Industries, Calcutta and (iii) M/s B.K. Poddar, Calcutta. The process package know-how has been prepared and copies sent to the firms through NRDC. The capacities of the first two plants are 20,000 bricks per day each, while the third could produce 84,000 bricks per day.

A process package know-how of the process on chemical demineralisation of coal, which was released to M/s Premium Coke Manufacturing Co. (P) Ltd., Dhanbad, for pilot plant development of the CFRI process, has been prepared and supplied to a consultancy firm for preparation of a feasibility report and design of the pilot plant (capacity 3 tpd).

The 75 kg per hour fluidized bed combustor-cum-air heater experimental plant has been commissioned at CFRI. The unit is capable of generating 1600 Nm^3 of hot air per hour at 160°C from the heat exchanger and 2500 Nm^3 of hot air per hour at 240°C from the immersed tube in the furnace bed. The hot air is suitable for use as a drying agent in industries such as parboiling of paddy and drying of tea. The technology is ready for transfer.

As continuous technical assistance to industry, Kharasang, North Gujarat and Ratna crude oils were evaluated at the request of ONGC, OIDB, OCC and Oil India Ltd., and reports issued by IIP. For Assam Oil Division of IOC,

investigations were continued on the feasibility of making quality bitumens from Assam Crude Mix. For Hindustan Petroleum Corporation, studies were taken up on the feasibility of producing lube base stocks from the changed reduced crude oil now under process in the refinery. Studies were initiated on a newer solvent (N-methyl pyrolidone) reported for application in the extraction of lube distillates with a view to assessing its quality as regards selectivity, low energy consumption and possible application in existing plants.

For conservation of petroleum products, a number of investigations have been taken up by IIP. Fuel economy improvement studies on two-stroke engines/vehicles (Vijay and 100 c.c. Cento) were taken up against sponsorship from M/s Scooters India Ltd., and PCRA. For optimum utilization, studies against sponsorship from OCC and at the initiative of the Institute were conducted on the effect of fuel properties on engine performance. Studies are in progress on the performance evaluation of 2-stroke engine oils supplied by M/s Lubrizol India Ltd. Performance evaluation studies on hydraulic transmission fluids were completed for the product supplied by HPCL, Bombay.

The low air pressure industrial burner effecting an improvement of 25 per cent in fuel efficiency licensed by IIP last year has gone into commercial production. More than 250 units have been installed in various industrial enterprise in the country so far. The feedback from industry indicates a saving of 15-25 per cent in consumption of fuel oil. Two workshops—one at BHEL, Hardwar and the other at SAIL, Delhi—aimed to popularize the use of the improved burner were organized by IIP.

A specially designed acoustic burner has been fabricated by RRL (Bhu.) and experimental parameters for combustion of oil-water emulsion on 30 litres per hour scale have been developed with a saving of 15-20% of furnace oil. A 500 litres per hour capacity burner designed and fabricated by the Laboratory is in the process of being demonstrated at Rourkela Steel Plant.

This project was undertaken in collaboration with SAIL R&D Centre, Ranchi, with the objective of minimising furnace oil consumption by the industrial oil-fired furnaces in steel industries.

MACHINERY DEVELOPMENT

The existing method of electro-chemical deburring suffers from various disadvantages, including preparation of cathode to suit each individual job. CMERI worked up a unique method called conforming electrode electrochemical deburring. In this process, the cathode is not required to be changed for each application but graphite balls placed in the electrolyte solution are stirred at a speed dependent on other process parameters. The Institute has developed a prototype machine working on the above deburring process. Samples sent by M/s Vanaz Engineering (P) Ltd., Pune and Union Bearing Co., Gujarat have been successfully deburred. Two more prototypes are being fabricated.

MERADO, Ludhiana, has designed and developed a 2-Needle 5-Threads Safety Stitch High Speed Overlock Machine (5500 stitches per minute) capable of performing simultaneously and continuously the following operations during stitching:

Stitching with double-lock chain stitch.

Trimming of edges with uniform margin from chain stitch seam.

Edge binding the trimmed edges with overlock stitch.

Apart from the design of the machine, MERADO has also developed the complete production tooling for the manufacture of its various components. The machine has been developed on a standardisation concept wherein majority of the critical components and sub-assemblies have been designed in such a fashion that these can be used in other models under development, viz. 2-Needle 4-Threads Mock Safety Stitch Machine (5500 stitches/minute); 1-Needle 3-Threads Overlock Machine (6000 stitches/minute).

The machine is ideally suited for stitching closing seams of shirts, trousers, pyjama suits, hosiery and knitwear. Its application in stitching ranges from delicate cloth to medium heavy cloth like Denim without sewing defects like puckering. The commercial manufacture of this machine is bound to give a boost to the readymade garment manufacturing industry and larger tailoring establishments and to result in improved quality of work and increased productivity.

Prototypes have been put through rigorous user trials and know-how is being transferred to interested parties.

MERADO, Ludhiana, has designed and developed an Automatic Brick Moulding Machine in collaboration with National Buildings Organisation (NBO), New Delhi. The machine is designed to produce about 1750 bricks per hour at 90% working efficiency. It has been established that bricks produced by machine moulding have high crushing strength, better surface finish and less pronounced tendency to develop cracks during firing compared to the hand moulded bricks.

M/s Andhra Pradesh Heavy Machine Engineering Ltd. (APHMEL), Vijayawada were rendered aid in completing and successfully testing the

prototype for an autospraying and drying unit, for which the design drawings were given by CLRI.

CFTRI is assisting the Bihar Fruit & Vegetable Development Corporation, Patna, in setting up a fruit processing plant capable of processing 50 tonnes of tomato, or 20 tonnes of mango, or 10 tonnes of pineapple, or 5 tonnes of leechi in one day, and producing 10,000 bottles of juice per day.

Civil Engineering

Field trials on partial substitution of chrysotile asbestos by polypropylene fibres in the manufacture of corrugated asbestos cement sheets and plain a.c. building boards were conducted by CBRI at M/s Rohtas Industries Ltd., Dalmianagar.

The test results showed that with a part replacement of chrysotile asbestos with polyprophylene fibre, corrugated sheets and plain boards conforming to ISI specifications can be manufactured.

In the field of water tanks, a comprehensive programme package was developed by SERC (M) for the analysis, design and estimation of Intze type container frame staging and circular raft foundation.

SURVEYS & ANALYSES

During the year, the two research vessels, viz. *Gaveshani* and *Sagar Kanya* completed 25 cruises, 18 by *R.V. Gaveshani* and 7 by ORV *Sagar Kanya* acquired recently by the Department of Ocean Development, Government of India and entrusted to NIO. Data were also collected during the maiden voyage of *Sagar Kanya* from Travemunde (West Germany) to India. Three of the cruises were devoted to training and acquainting personnel with the working of various sophisticated equipment on board. Scientists from the India Meteorological Department, Indian Navy, Centre For Advanced Study in Marine Biology, Porto Novo and Andhra and Berhampur Universities were trained in operation of various oceanographic equipment and methods of data collection. A cruise each by *Gaveshani* and *Sagar Kanya* was carried out in Sri Lankan and Kenyan (Mombassa) waters respectively.

NPL has successfully designed, developed and assembled a low capacity liquid air plant based on Stirling Cycle. This plant has been put on trial runs also in the recent past for short durations, and liquid air obtained. The plant involves as many as 2000 precision components. Work is being continued.

Ethnobotanical surveys in 6 districts of Madhya Pradesh, viz. Chhindwara, Betul, Mandla, Jhabua, Bastar and Dhar, inhabited by 8 important tribes were carried out by NBRI. More than 500 plants and plant products used by these tribals for food, fodder, fibre, fuel, medicine, including contraceptive drugs, timber, oil, gum and resin were collected, identified and documented.

The studies revealed that plant resources of these 6 districts are quite rich in raw materials for establishment of forest-based cottage industries and for extraction of oil, making toys, house building materials, fibres, brooms and baskets and collection of herbal drugs.

The survey of airborne pollen and spores from 16 centres in India had been completed and a report on the results obtained was prepared by NBRI incorporating the main results.

At CLRI and its regional centres, 467 leather samples were assessed for issue of certificates in connection with exports.

The Bihar State Forest Development Corporation and the Bihar State Leather Development Corporation were assisted by CLRI in setting up a vegetable tannin extract unit of 3 tonnes per day capacity (spray dried extract) at a cost of Rs 1.20 crore.

Seventy practical demonstrations of processes of leather-making were carried out by CLRI at 41 different places in the country.

About 11,000 samples of fruit and vegetable products (mainly meant for export) were analysed by CFTRI under the Fruit Products Order of the Government of India. The defects were brought to the notice of the manufacturers through the concerned government agencies. The rejection during the year was hardly 1.3% as compared to 2.6% in the previous year. The

Central Food Laboratory functioning at CFTRI also analysed 3726 samples referred to it by DGHS.

Under an UNCTAD assignment, CFTRI carried out a study of food processing capabilities at Sierra Leone to draw up a recommendatory report. Based on the study, a draft report which includes profiles of 18 projects and a comprehensive plan suggesting the scope for further development of the food industry has been furnished.

The project 'Road user cost study in India' was carried out by CRRI, under the joint sponsorship of the World Bank, Union Ministry of Shipping and Transport and CSIR. This project was intended for providing the much needed data on the effect of road conditions on traffice flow, user costs, including petrol consumption and safety, so that planning and prioritisation of road projects could be carried out more rationally through cost-benefit evaluations. The study is proving extremely useful in meeting the requirements of cost-benefit aspects for negotiating the Rs 400 crore loan from the World Bank for improvement of certain trunk roads.

A Rs 60 lakh consultancy assignment on the road network planning for Bombay Metropolitan Region has been completed by CRRI. As many as 14 surveys and studies were conducted which formed the basis for calibrating the transport model for the base year (1979), and the design year (2001) traffic flows. Keeping in view the various factors of traffic and transportation for the Region, a system of freeways, expressways and major arterial roads has been identified.

ECOLOGY AND ENVIRONMENT

The air around Taj Mahal has been continuously monitored to determine the possible effects of sulphur dioxide on the monument. Emission inventory of select foundries at Agra has also been prepared. Arising out of NEERI's recommendations, an old thermal power station has been closed and the railways have switched over from stream to diesel locomotives in the marshalling yard.

In the coordinated project relating to the development of a suitable technology for the abatement of pollution caused by the emission of sulphurous gases from the foundry cupolas and other metallurgical industries at Agra, the presence of sulphurous gases was monitored by scientists from NEERI and the results showed that 90-95% of sulphurous gases could be eliminated from the discharge gases.

The Department of Environment assigned IIP the task of preparing a state-of-art report on vehicle emissions and generation of base line emission data for Indian vehicles. A team of IIP engineers conducted an on-the-spot survey in Delhi. This will provide the data base necessary for developing technologies and measures to control emissions.

SCIENCE, TECHNOLOGY & DEVELOPMENT STUDIES

A study entitled "International Comparative Study on the Organization and Performance of Research Units (ICSOPRU)" is being carried out by NISTADS in cooperation with UNESCO to collect data from different countries and to have a systematic body of knowledge on the social, organizational and environmental conditions which are conductive to effective performance of research and development. Data collected from CSIR laboratories are being analysed.

The study on 'Science and Technology as Vectors of Change in the Arts and Mass Media: 1947-1983' was completed. It brought out the relationship between technology and art through a historical analysis. Three case studies have been prepared on the interface of technology and architecture during post-Independence period.

The study on the Control of Pest Infestations: Policies for the Pesticide Industry in India aims at examining the strategies for the development of pesticide industry in India, role of R&D and the question of toxicity in the pesticide industry. A general review of the pesticide industry, its structure and growth in India has been made. Analysis of patents filed during 1970-79 on synthetic pesticides in India has been done.

A project on Studies on History of Science in Ancient India undertaken at Calcutta aims to trace the development of science and scientific thought in India (from the earliest time to roughly the 12th century AD) in the perspective of the history of world science and with the awareness of the complex interconnection of science with social organization, technology, craftlore and belief system. Archaeological data, throwing light on technological achievements or their absence, have been collected on (i) the period culminating in the First Urbanisation (Mature Harappan Culture), (ii) the period intervening between the extinction of First Urbanisation and the new beginnings towards Second Urbanisation, and (iii) the period culminating in Second Urbanisation.

Another study on the History of Science and Technology in Medieval India (1200-1800 A D) is being undertaken at Lucknow.

The project on Colonial Science and Indian Response aims to know how the Indians reacted to the introduction of Western science in the country during the British rule and to assess the impact it had on the emergence of scientific institutions, technological projects and industrial development. A paper on 'Science in Agriculture: A study in Victorian India' has been prepared.

The project on 'Application of Science and Technology to Different Sectors of Economy in China' envisages identification of factors which led to successes and failures in certain areas of development in China. A report is under preparation.

A study on Oceanography and Indian Tradition has been initiated in collaboration with the Tamil University, Tanjore and Faroke College, Calicut University. The objective of the project is to collect the available information and develop a systematic account of the knowledge and technology generated in the field of oceanography in India.

A new project on Archives of Science and Technology has been started with a view to locating, identifying and retrieving Science and Technology Information (STI) contained in the hitherto unexploited archival resources of the country and make it available to research workers through appropriate reference media and publications, including microforms. Progress has been made in location, identification, retrieval and descriptive listing of the relevant materials in the National Archieves of India, Archives of Uttar Pradesh, Tamil Nadu, Maharashtra and Gujarat.

DISSEMINATION OF INFORMATION

PID continued to publish thirteen scientific journals and periodicals (total number of pages about 7400).

The first volume of the revised series of the Wealth of India: Raw Material Series and the seventh volume of Bharat Ki Sampada: Prakritic Padarth are in press.

The Directorate brought out a directory of scientific and technical publications in Hindi under the title "Hindi Vaigyanik our Takniki Prakashan Nideshika: 1966-80". The publication was released on 27 October 1983 by the Prime Minister, Smt. Indira Gandhi.

The second supplement of the Glossary of Indian Medicinal Plants, and Dictionary of Useful Plants of India were in advanced stages of publication.

The Hindi popular science monthly, Vigyan Pragati, in the 33rd year of publication, crossed a circulation of more than a lakh of copies. To celebrate this landmark in circulation, the Directorate held a function on 22 February 1984, at which Shri Shivraj V. Patil, Minister of State for Science and



Smt. Indira Gandhi, Prime Minister, and President of CSIR, releasing the publication "Hindi Vaigyanik aur Takniki Prakashan Nideshika" brought out by the Publications & Information Directorate. Seen with her is Shri Shivraj V. Patil, Union Minister of State for Science and Technology, and Vice President of CSIR. The publication was released on 27 *October* 1983.

Technology, and Vice President of CSIR, released the January 1984 number of the magazine.

INSDOC continued to publish the Indian Science Abstracts (monthly, Vol. 18-19). During the year, it published under the state-of-art series, a report on the Solid Waste Management in the Developing Countries. The Directory of Current Research Projects in CSIR Laboratories, giving descriptions of about 1,700 research projects (current up to the end of 1981) was also brought out. Work is in progress on the compilation and publication of a revised edition of the Directory of Scientific Research Institutions in India and of the National Union Catalogue of Scientific Serials in Indian Libraries.

INSDOC and its Regional Centres at Bangalore, Calcutta and Madras, complied with 16294 orders for document copies, 203 orders for preparation of bibliographies and 1,117 orders (14,798 typed pages) for translation from foreign languages into English. It is subscribing to CA Search, INSPEC and COMPENDEX data bases for offering SDI service to scientists and technologists. The output of reprography service was 1,57,276 pages of paper photocopies, 1,57,250 pages of microfilm and 617 slides. The in-house printing unit produced about 25,000 pages of scientific text.

The National Science Library of INSDOC continued its collection building programme and the services. During the year, it added 5,388 volumes and received 4,617 titles of scientific periodicals. The total collection was 1,13,948 volumes. The Russian Science Information Centre received about 2,000 and 230 Russian books and journals respectively from VINITI, Moscow.

NISTADS continues to publish the monthly journal entitled 'Current Literature on Science of Science'. With a view to disseminating recent information and highlighting current developments in the field of science of science in developing countries it publishes book reviews, digests, reports, abstracts of articles and news and notes. A new section on R&D statistics has been added.

CSIO continued the publication of its quarterly journal 'CSIO Communications'. The journal carries scientific papers, information about new instruments developed at CSIO, relevant news items and new instruments/ equipment developed by the industrial organisations in the country and abroad.

A special report on Desalination Research at CSMCRI was brought out. The report covers 20 years of research and development efforts of CSMCRI in the area of desalination. Technologies based on reverse osmosis, electodialysis and solar stills for water desalination have been described in detail. The report was released during the Third National Conference on Water Desalination held at the Institute during 10-12 February 1984.

The DST-sponsored National Information Centre for Drugs and Pharmaceuticals at CDRI continued to publish the monthly bulletins: Current

Highlights (R&D), Industry Highlights, Patent Awareness and Current Indian Titles.

The National Information Centre for Food Science and Technology continued its functions (with support from CFTRI & DST) through its services, Food Technology Abstracts (monthly), Food Digests (quarterly) and Food Patents (quarterly). A new service entitled "Microform Information Service" was initiated; it contained about 400 entries. Two bibliographies, one on "Aseptic Packaging" and the other on "Extruded Products" were prepared and furnished.

The National Information Centre for Leather and Allied Industries (NICLAI) at CLRI continued to publish monthly periodicals—Current Leather Literature and Trends in Leather World with Manufacturers' Corner and also SDI service 'Leathlars'.

NEERI continued to publish the Indian Journal of Environmental Health (quarterly, vols. 24-25), Guide to Current Literature in Environmental Engineering and Science (monthly, vols. 14-15) and training course manuals in specialised fields of environmental science and engineering.

A book entitled "Solid Waste Management in Developing Countries" by D. Bhide and Dr B.B. Sundaresan has been brought out. It was released by Shri Shivraj V. Patil, Union Minister of state for Science and Technology and Vice President of CSIR, at the CSIR Directors' Conference held at Bombay during 19-20 October 1983.

INTERNATIONAL SYMPOSIA

A three-day international conference on Chemical Reaction Engineering was held at NCL, Pune, during 9-11 January 1984. This conference provided a rare opportunity for several top scientists working in the field in India and abroad to come together and discuss problems of mutual interest.

As a part of its Silver Jubilee celebrations, CIMAP organised an International Symposium on Medicinal and Aromatic Plants during 26-28 December 1983. The Symposium was attended by distinguished scientists from India, Iran, Afghanistan, Turkey, Pakistan, Bangladesh, Japan, Hong-Kong, Australia, South Korea, Papua New Guinea, Sri Lanka, Malaysia, Thailand, Fiji, Tanzania, UK and West Germany. The deliberations centred on the latest technologies available and ways and means by which developing countries could pool their physical and manpower resources for mutual benefit. The symposium was sponsored by CSIR, the Regional Centre for Technology Transfer for the Economic and Social Commission for Asia and the Pacific (RCTT/ESCAP) and the International Foundation for Science (IFS).

A workshop on traditional food technologies was organised by the United Nations University at CFTRI, Mysore during 18-26 July 1983. Thirtyseven specialists from 22 countries of Africa, Asia, Latin America, Canada, The Netherlands, Hungary, USA and UN agencies participated. Nearly 300 products from 10 countries were displayed in the exhibition organised on the occasion.

At the request of UNCHS, Nairobi, SERC organised a workshop on "Housing, infrastructure and services for low-income groups in developing countries". This attracted high level participation: 9 from India and 10 from developing countries of Asia, Africa and South America.

An Indo-US Workshop on Solar Terrestrial Physics was held at NPL during 30 January-3 February 1984. The Workshop, sponsored by the Department of Science and Technology (Government of India) was attended by about 90 active workers in this field, including 26 scientists from USA. The major aim of the Workshop was to review the progress in this field during the Solar Maximum Year and to identify viable collaborative programmes between the Indian and the US institutions.

The 19th Tanners' Get-together on 'National Perspectives of Development of Leather and Allied Industries', organized in the last week of January 1984 by CLRI was attended by 500 delegates from India and abroad; 55 papers were presented. The International Leather Fair was held during 31 January-4 February 1984 at Madras under the joint auspices of CLRI and the Indian Leather Fair Society.

An International Symposium on 'Neurotoxic Substances and Their Impact on Human Health' was organised by ITRC in collaboration with the International Brain Research Organisation during 4-6 February 1984. It was attended by 14 eminent neurotoxicologists from USA and 86 scientists from different research institutions in India.

TRAINING COURSES

The international training centre functioning at CFTRI has trained 19 students who were awarded M.Sc. degree in food technology of Mysore University in 1983.

CIMAP organised a Commonwealth Science Council Training Workshop on Standardisation and Quality Control of Plant Drugs from 29 December 1983 to 3 January 1984. Officials of Commonwealth Science Council and trainees from different Commonwealth countries participated. The workshop laid stress on different aspects like macro- and microscopical examination of herbal drugs, advanced techniques for their chemical examination and collection of ethno-botanical information and herbal specifications.

A group of 9 scientists from Bangladesh, belonging to the Botany Department of Dhaka University were trained in general tissue culture methods at NBRI under a programme drawn by UNESCO from 23 December 1983 to 6 January 1984.

The Indo-Swiss Training Centre of CSIO continued to conduct its regular training programmes, namely three-year diploma course in Instrument Technology, one-year post-diploma course in Industrial Technology and one-year Post-diploma courses in Industrial Electronics and Die and Mould Making. This year, 65 trainees successfully completed Diploma in Instrument Technology, 12 qualified for Post-diploma in Industrial Electronics and 20 graduated in Post-diploma in Die and Mould Making.

A training and orientation course was arranged by CBRI for the officers of Maharashtra State PWD From 22 to 24 November 1983. Seven officers of the rank of Executive Engineer, drawn from various parts of the state, attended this course. Demonstration of casting of a few prefabricated components developed at the Institute was also arranged for the participants.

A training programme on recent developments in rural building techniques was arranged by CBRI at Jodhpur (Rajasthan). The training programme was sponsored by the Consortium of Rural Technology (CORT). At the end of the training programme, a live demonstration of fire retardant treatment of thatch roofs was arranged for the local villagers and trainees in addition to the participants in the programme.

A Masons' Training Course was held at CBRI Hyderabad Extension Centre in November 1983 where training on prefab units and use of improved construction gadgets was given. A training course was arranged from 15 to 20 November 1983 at the CBRI Extension Centre (Bhopal), for 40 masons. They were given guidance in the use of prefabricated components and improved gadgets for increased efficiency and better quality of work.

A training course on 'Repair, maintenance and handling of TV and allied equipment' was conducted by the S&M Centre, Delhi of CSIO from 18 July to 12 August 1983 for the students of post-diploma in Applied Electronics, Department of Physics, Jammu University, Jammu.

TRAINING COURSES

INSCOC continued its regular training course in Information Science. The 19th session of the Course terminated with 13 students.

The District Rural Development Authority (DRDA), Jammu, has started a programme of rabbit rearing in the cold regions of Udhampur for the benefit of rural masses. The training programme is being conducted by RRL-Jammu. In the first phase, training was started in February and the first batch of 10 trainees completed their training in March 1984.

Administrative Management in R&D—an orientation programme for Personal Secretaries/Senior Personal Assistants of CSIR laboratories—was organised at NIO, Goa, 19 March-3 April 1984. Forty participants from thirty national laboratories of CSIR took part in this programme.

OTHER ACTIVITIES

A nucleus for the regional research station of CRRI for heavy rainfall region was set up at Dimapur in Nagaland and the work on the road problems in that sector and other R&D work pertaining to these areas was initiated.

RRL, Bhopal has been identified as a major centre in the area of Materials Technology, by CSIR, and has started functioning in temporary laboratories.

CSIO continued to extend repair and maintenance service of scientific and industrial instruments through its network in nine Service and Maintenance Centres in the country. This year, the Centres repaired over 1900 instruments valued at approximately Rs 275 lakh and earned service charges around Rs 9.27 lakh. Specialised technical assistance was rendered by CSIO to a number of industries, government departments and research and educational institutions. A total amount of about Rs 2.5 lakh has been earned as the charges for rendering this assistance during the year.

Standards

Standards of Physical Measurements and Calibration Facilities of NPL.

New Calibration and Testing Facilities established:

Testing of Ultra-High Vacuum Systems: An ultra-high vacuum system using ion pumps and sublimation pump has been commissioned at NPL. Vacuum of the order of 6×10^{-11} m bar has been obtained. Mass spectrochemical analysis of residual gases in this system is in progress.

Testing of Evaporative Coolers: Test facilities for testing of evaporative coolers (as per ISI specifications) have been established at NPL for the first time in the country. The facility is offered to manufacturers of such coolers.

Standard Voltage and Voltage Ratio: Standard voltages (1 V to 1000 V) and voltage ratio based on precision DC calibrator and Kelvin Varlay divider with traceability to primary standard of DC voltage have been established by NPL.

Calibration of Coaxial Bolometer Mounts: An adapter technique as well as the direct comparison technique have been established for the calibration of coaxial or waveguide primary standards in the 5.8 to 8.2 GHz and 8.2 to 12.4 GHz bands. The total uncertainty in the calibration lies within ± 1.0 to $\pm 1.5\%$, depending upon the frequency band and the VSWR of the bolometer mount to be calibrated.

Intercomparison of Standards: Intercomparisons of High Frequency Attenuators were carried out among Australia, China, India and Singapore. The travelling standards used were H.F. attenuators of 3, 6, 10, 20 and 40 dB calibrated at 30 MHz.

Intercomparison of standards has also been going on with the D.I. Mendeleyev Institute of Metrology (VNIIM), Leningrad, under the Indo-Soviet Collaborative Programme in Standardization and Metrology. Intercomparisons undertaken so far include standards of DC Voltage and Resistance, LF and HF Voltage up to 30 MHz and Capacitance.

A travelling atomic clock intercomparison with VNIIFTRI, Moscow, USSR and of inductance standard at 10 mH level, were carried out.

BASIC RESEARCH

Physics

Indian Middle Atmosphere Programme

Ozone Intercomparison Campaign

Several rocket flights were held from TERLS during the last week of March 1983 under the ozone intercomparison campaign as a joint programme between India and the USSR. NPL, New Delhi, Physical Research Laboratory (PRL), Ahmedabad, and the India Meteorological Department (IMD) were involved from the Indian side in this campaign. The data from NPL payload were analysed and compared initially with PRL and Russian data and found to be in good agreement with both.

Solar UV-B Measurements

Analysis of the data collected by NPL during the past four years for direct and diffuse components of solar UV-B at 290 nm and 310 nm wavelength region (using the photometer developed at the Laboratory) has shown that variation of UV-B radiation with ozone concentration is highly dependent on wavelength and angle of solar zenith. The atmospheric conditions play a major role in the actual amount of radiation reaching the ground. Solar UV-B radiations were monitored continuously from 15 December 1983 to 29 February 1984 for more detailed study.

Chain of Satellite Beacon Monitoring Stations

The chain of satellite beacon monitoring stations at Delhi, Hyderabad, Bangalore and SHAR was maintained and the data were continuously collected at all the stations using ETS-II satellite radio beacon. In addition, a triangular chain of stations was set up in January 1984 around Hyderabad in order to study the travelling ionospheric disturbances.

Radar Duct Propagation and Ranging Using Ray Optics

During the first phase of a new programme on marine communication undertaken during 1983, NPL concentrated its efforts on radar duct propagation and ranging using ray optics. A computer program was exclusively developed by the Radio Science Division of the Laboratory to model radar propagation in evaporation ducts using the marine meteorological data collected by IMD and other organisations under the auspices of the World Meteorological Organization (WMO). Work so far completed includes (a) estimation of duct thickness in the Indian Ocean, (b) range of estimates based on interference lobe theory, and (c) comparison of observed leakage in duct propagation with the estimated signal enhancement (12 dB) from ray optics approach.

Non-Equilibrium Superconducting State in Pb-Pb_xO_y-Pb Type Josephson Tunnel Junctions

Studies conducted at NPL non-equilibrium superconducting state (NES) in Pb-Pb_xO_y-Pb type Josephson tunnel junctions, by producing NES by both external (microwave) and internal (self-injection of quasiparticles) stimulations, have yielded interesting results.

Binary and ternary compounds of bismuth containing 3d magnetic elements like Cr, Fe, Co, Ni were synthesized at NPL using rapid quenching techniques. It has been found for the first time that in binaries Bi_3Cr is superconducting with T_c of 4.2 K and T_c is enhanced to 10.3 K when Bi_3Ni is splat quenched. This is the highest T_c reported for compounds with 3d magnetic elements. The ternary systems which have exhibited superconductivity are Bi_3 (Cr, Co) and Bi_3 (Ni, Co).

Study of Microstructural Changes Induced by Microwave Electric Fields in Silicon Single Crystals by High Resolution X-ray Diffraction Methods

A series of experiments were performed in this area in collaboration with the PTB, Braunchweig, F.R.G., by using high resolution X-ray diffraction methods developed at NPL. Reversible and irreversible changes due to microwaves in silicon crystals have been observed. These changes are observed in the curvature measurements as well as in high resolution topographs. Reversible changes are observed even at low microwave powers of about 30 mW. Some of these results are similar to the earlier work at dc and low frequency fields. The radius of curvature changes from 25 m to about 40 m as a result of application of microwave electric fields. It appears that the dispersion surface of the crystal is being strongly influenced by the microwave fields. In free field experiments also remarkable changes have been observed.

Single crystal studies by X-ray diffraction carried out at NPL on a defect zinc-blend $A_2III\ B_3IV$ compound Ga_2Te_3 have indicated a unique feature of satellite reflections associated with reflections of the parent Ga_2Te_3 lattice. To the first approximation, these effects have been understood on the model of periodic displacements of (111) layers arising as a result of anionic displacement along the four equivalent tetrahedral bond directions.

Geophysics

The MAGSAT data over the Indian sub-continent have led to the following interesting results:

1. a reasonable one-to-one correlation in spatial wavelength and location to the geotidal flow of central Indian Ocean and the MAGSAT vertical intensity component in the same region, suggesting a common causative source;

2. quite different magnetic characteristics over different blocks of the Himalayas with a prominent low over the Kumaon range which may be due to a localised but deep tectonic activity;
3. a clear reflection of the magnetic signature of the Narmada-Son lineament at the satellite heights; and
4. distinct demarcations of these geological provinces, viz. Peninsular India, Singhbhum Craton and the Himalayas.

The variation pattern of the earth's past climates and magnetic field for the last two million years when examined using an appropriately suited mathematical technique shows statistically significant periodicities of approximately 43,000 and 21,000 years for the former and 92,000, 43,000 and 21,000 for the latter. These are surprisingly close to the well known periodicities of the earth's orbital motions. These results are at variance with the earlier works and will intensify the present controversy seeking a cause and effect relationship between the gravitational field and earth's magnetic and climatic changes. Due to changes in the earth's rotation, the length of the day (LOD) also fluctuates. Employing Walsh spectral analysis technique, data of LOD and atmospheric circulation, it has been possible to show, hitherto unresolved periodicities of 26 months (the quasibiennial term) and that of 40-44 months. The 66 month periodicity in LOD is due to some non-meteorological cause.

Oceanography

Bi-spectrum and wave-propagation studies carried out under modelling programme indicated that the bi-spectrum of sea surface displacements is real, but has had variance properties. These studies also reveal that the quantitative conclusions found in literature need some modifications. The validation of such studies on bi-spectrum of the sea surface gravity required a wave record of a few hours' duration under stationary conditions.

Work on the simulation of wind driven circulation of the Bay of Bengal using a constant south-westerly wind has been completed. The simulated circulation pattern agrees fairly well with the observed circulation pattern during the south-west monsoon. Similarly, storm surge profiles were computed using numerical filters from available sealevel data recorded at 5 stations along the east coast of India during the storms which occurred between 1968 and 1973. Using the Bathystrophic storm tide theory, nomograms for the estimation of wind-induced surge for selected stations along the east coast of India were prepared.

A wave atlas for the northern Indian Ocean with equator, Asiatic land mass, 60° and 95°E meridian as boundaries has been prepared and issued. The atlas depicts the percentage frequency of occurrence of waves with direction, height and period. The calmness of the sea can also be read.

For offshore design and operation and coastal developments, the long-term data collection on waves and currents was initiated off Kakinada, Machilipatnam and at Bombay High. Three waverider buoys have been deployed, one each in the above areas at contours of 20, 75 and 88 m respectively. The wave receiving/recording station in the former two stations is being operated in remote coastal villages, while in Bombay High, it is on the offshore drilling vessel, *Sagar Samrat*. Wave records for 20 minutes are obtained for every 3 minutes both on chart paper and digital magnetic tapes.

Chemical studies

In the coordinated studies on chemical investigations of marine extracts, 30 new species were collected mainly from Malvan, Ratnagiri and Andamans. The concentrated extracts prepared from these are under screening for biological activities at CDRI, Lucknow. In one of the algal members, viz. *Codium elongatum*, the polysaccharide fraction was found to exhibit an antiviral activity against Ranikhet disease virus. This polysaccharide fraction, which is polygalactan in nature, yielded galactose and arabinose on acid hydrolysis. Similar studies were also continued on *Acanthophora sperifera* (antifertility activity), *Corallina officinalis* (antifertility) and other members.

Several observations on floating tar balls in the Central Indian Ocean, western Arabian Sea and the Somali basin were made using catamaran-type neuston net available on board RV *Sagar Kanya*. Based on data available, it was computed that about 8400 tonnes of floating tar can be expected in these areas at any time of the year.

Biological aspects of oceanography

Estimation of phytoplankton pigments in south Gujarat estuaries, viz. Auranga, Ambika, Purna and Mindola, indicated that all of them are fairly productive. The Lakshadweep sea showed a mean primary production of 200 $mgC/m^2/d$ in the euphotic zone. The zooplankton biomass in the Sri Lankan and Maldives waters was found to fluctuate.

Faunal and species distribution of zooplankton in Antarctica waters showed a lot species diversity compared to the tropical and temperature oceanic realms. Common copepod species encountered were *Calanus simillimus*, *C. propincuus*, *Calanoides acutus* and *Rhincalanus gigas*. Geographical variation in distribution of major group and species of zooplankton in Antarctica was found to be mainly due to temperature and availability of food. Krill resources of Antarctica were represented by swarming *Euphausia superba* Dana (biomass 22-120 mg/m^3). Stock was represented by commercially important size range of 30-45 mm.

Survey on deep sea benthos was carried out between 1-19°S Lat. and 70-83°E Long. occupying 47 stations in the depth range of 2000-5400 m. Fauna

population was rich (5500/m^2), while biomass production was found to be 2.5 g/m^2. Studies on long-term changes in structure and composition of commercial clam beds in the Mandovi-Cumbarjua Canal-Zuari estuarine complex of Goa showed drastic changes and showed a decline from 1.3 kg/m^2 in 1971-72 to 0.1 kg/m^2 in 1982-83 in exploitable clam resources due to the refuse from mines.

Marine microbiological studies on distribution and density of *Vibrio parahaemolyticus*-like (VPLO) organisms in the Indian Ocean and Arabian Sea were continued. Nearly 400 strains were isolated during the 116th cruise of RV *Gaveshani* for the study of biochemical and physiological properties. These organisms are found to be more common near the Laccadive islands than the offshore areas. The average density of these organisms observed during cruise IV or RV *Sagar Kanya* varied from 19 to 712/100 ml.

Analysis of water samples from different depths (5-300 m) for *Thiobacillus denitrificans*-like organisms (TDLO) showed an average range of 8-900/litre and 18-900/litre at 5 and 30 m depths respectively.

Marine algal pathology taken up recently indicated that there are a number of parasites on these algae which are hitherto unreported from India. The alga *Cladphora* was found to harbour two parasitic phycomycetous fungi, viz. *Cladochytrium* and *Sirolpidium*, both of which are reported for the first time in India.

Aquaculture

Large scale mass culture of feed organisms such as harpacticoid copepods, nematodes and rotifers, as a food for cultivable fishes was continued. Cultivation of economically important algal members, such as Hypnea, Sargassum, *Gracilaria* by net cultivation method tried at Malwan (Maharashtra coast) and that of *Monostroma* sp. tried at Dona Paula showed encouraging results.

Culture of green mussel *Perna viridis* L. under the laboratory seawater circulating system showed an annual growth of 89 mm as against 60 mm in the natural beds.

An experimental study was carried out to ascertain the possibility of transforming the juvenile fishery into a seed fishery with the cooperation of dragnet fishermen who use the smallest meshed net for the capture of early juveniles.

Chemistry

New carbonyl complexes of ruthenium, rhodium and iridium

Many new carbonyl complexes of ruthenium, rhodium and iridium with the metals in the lower oxidation states have been synthesised and characterised.

Tridentate chelating ligands such as hydrazones and azines also gave new compounds. Carbon monoxide could be introduced into the molecule after the replacement of chlorine atoms of stabilized metal chloride complexes. Addition of acrylic esters to hydrido carbonyl compounds of ruthenium gave metal-carbon direct bonded derivatives containing propionic ester groups.

Theoretical chemistry

Formal development of many-body theories to calculate the correlation energy of atomic and molecular systems accurately has been done. Specifically, the formal developments are taking place in the field of closed and open shell coupled cluster theories and many-body perturbation techniques. The process of chemisorption is being studied by using *ab-initio* quantum chemical methods.

Catalysis and adsorption

Fundamental knowledge of the processes is of great value. Work carried out in the past two years at NCL has resulted in considerable progress towards accurate prediction of catalytic rates, which is a prerequisite for sound design strategies. The significant achievements include the solution of the adsorption integral equation for accurate activity distribution function and also a method for the prediction and control of selectivities for complex industrial processes (platforming is an illustrative example). Over 14 papers have been accepted for publication/published in leading science and engineering journals. A dozen more are to be communicated shortly.

Stochastic analysis of chemically reacting systems

The conventional analysis of chemically reacting systems formulated in terms of the macroscopic equations represents an approximation wherein the inherent random fluctuations arising due to the discreteness of the system are ignored. Situations in real practice might arise when more rigorous formulations that incorporate the discreteness of matter and eventual fluctuation in its properties are necessary. Two types of situations wherein accounting of such formulation becomes essential have been identified: (i) finite size system, such as diffusion controlled reactions, reactions in cells, etc., and (ii) systems operating near the bifurcation points of the underlying macroscopic description. Mathematical models depicting the behavioural features of systems belonging to these classifications have been studied and comparison with macroscopic models indicated the important role of fluctuations. A new and rigorous approach has been evolved that complements the existing macroscopic approach and lays down the criterion for its validity or otherwise.

Polymer science and engineering

The effort in providing unified frameworks for analysis of transport process in polymeric media is continuing. An altered free volume state model has been proposed to correlate transport properties of polymers. The model can satisfactorily correlate diffusive transport in polymer solutions and gels as well as in solid polymers. The role of carrier action in dyeing was explained on the basis of the AFVS models.

A rigorous analysis of the limiting case of fully developed flow of polymer solutions through fine capillaries under the conditions of macromolecular migration was completed. This suggests that size dependence of flow curve may not always serve as a positive indication of effective slip.

A mathematical model has been developed to compute the molecular weight distribution (MWD) in polyethylene terephthalate (PET) manufacturing process and in blending of molten PET chips. The model is useful for calculating the time required to reach equilibrium MWD, essential for getting uniform product quality.

Effect of chemical surface treatment conditions on the electrical surface conductivity of fluorinated polymer films was studied comprehensively. Ideal conditions for the reaction were established to improve surface conductivity by a factor of 10^{10}.

A boron selective ion-exchange resin based on a chloromethylated styrene dvb matrix with N-methyl glucamine was synthesized with varying porosity and cross-linking. The exchange capacity of the resin for boron was 3.5 mg/g for seawater containing 7.5 mg boron/litre. The general capacity is comparable with that of the imported resin, Amberlite XE-243 whereas the exchange rate is as low as one eighth for 50 per cent exchange capacity.

Studies on a three-compartment electrolytic cell (26 cm × 13 cm) were conducted on a laboratory scale to obtain solid boric acid from borax with modifications for separation. At a current density of 30 mA/cm^2, the current efficiency was 95 per cent and the power requirement was 3.6 kWh/kg. The product after two washings with deionised water conforms to IS-263-1967 electronic condenser grade property.

A 19-compartment electrodialysis unit (effective cross-sectional area: 144 cm^2) was fabricated and the conditions of preparation of potassium carbonate from sodium carbonate and potassium sulphate were optimised to get 2 *N* solution. The current efficiency is about 95 per cent and the power consumption is 1.35 kWh/kg of potassium carbonate. The purity of the product is 98 per cent.

A porous monocarboxylic resin based on acrylonitrile and divinylbenzene was synthesised. Studies for the removal of hardness at different flow rate levels of calcium (1000-1500 ppm $CaCO_3$) revealed that at a flow rate of 5 bed vol/hr, the resin could treat 10 and 16 bed vol. respectively till breakthrough.

Divinylbenzene-based polymer with *p*-chloromethyl group has been synthesized and from it, polymers containing anchored polycarboxylic acid group were obtained. One of the chelating polymers based on N-methyl glucamine was found to take up boron up to 3 meq/ g from seawater.

A series of metal complexes of cobalt, nickel, iridium and ruthenium were synthesized, characterised and were successfully used for hydrogenation of jojoba oil.

Photoelectrochemical cells were prepared from cadmium selenide and cadmium sulphide which generated electrical voltage on exposure to sunlight. Another photoelectrochemical cell using naturally occurring haematite was prepared which yielded hydrogen from water and sunlight.

Chemically protective transport coatings on glass by sol-gel technique

The alkali-resistant properties of ZrO_2 in glasses are well-known, though such glasses, containing less than 20 wt per cent ZrO_2 require high temperature (1550°-1600°C) for preparation. The sol-gel technique, on the other hand, provided an alternative route for preparing chemically protective coatings of various compositions on glass and other substrates at low temperatures. In such coatings again, presence of ZrO_2 often causes hydrolysis precipitation and loss of transparency unless incorporated only in small percentages.

Using a modified form of the sol-gel technique, transparent amorphous coatings of pure ZrO_2 were obtained at the CGCRI for the first time on soda-lime glass by carefully controlled hydrolysis of the sol. The coatings were 600-1500 Å thick and transmitted 75-85 per cent of the visible light. The preparation required only a temperature of about 450°C. The coatings are likely to be useful for chemical protection of optical materials.

Development of rapid methods of chemical analysis

A number of new rapid methods of chemical analysis were developed, standardized and applied for quantitative determination of Ca, Mg, Mn, Al, Fe, Cd and Zn in a wide range of ceramic materials. The methods are based on the chemistry of sequential chelation of metals with EDTA involving masking, demasking and homogeneous precipitation in a multi-component system to enable the elements to be determined one after the other via stepwise complexometric titration in a single solution.

In vivo metabolism of a newly synthesised OPP analogue (RPR1) was studied in rat liver, kidney, lung and faeces. The metabolism took place through the routes of oxidation desulphuration, N-hydroxy methylation, deamination, cleavage of P – O alkyl linkage and dehydration.

Mass spectrometry

Studies on gaseous ion chemistry have revealed a novel bimolecular gas phase

reaction resulting in the reduction of olefinic bonds by ammonia in unsaturated dicarboxylates.

$(M+NH_4)^+ + NH_3 \rightarrow (M+3H)^+ + N_2H_4$

$(M+N_2H_7)^+ + NH_3 \rightarrow (M+NH_4+2H)^+ + N_2H_4$

Evidence was obtained for the combined effect of a phenyl and allylic bond in providing a competing site for anion formation only in the gas phase in some substituted 4-nitrocyclohexanes in addition to the expected site, $(H-\underset{|}{\overset{|}{C}}-NO_2)$. In solution, the anion is generated at $(H-C-NO_2)$ position only.

Metallurgy

(i) Grain refinement of wrought aluminium alloys

Experiments were performed to achieve grain refinement in Al-Cu alloys. Grain size achieved was in the range 12-15 micron. Grain size was not found to be stable at high temperature with the result that only extended plasticity (approx. 25% EI) could be achieved (project completed).

(ii) Solidification structures of Al-Cu alloys

The influence of solidification rates and volume of metal on the secondary dentrite spacing in Al-Cu alloys has been studied. The structure of liquid Al-Cu plays an important role in the solidification behaviour. Statistical regression analyses were carried out to establish various correlations between grain size-dentrite spacing and dentrite spacing-volume of metal (project completed).

(iii) Fracture studies in Mg-Al-Zn alloys

Work aimed at studying the influence of certain additional elements on the fracture behaviour of Mg-Al-Zn alloys and development of commercial production technology has been taken up. Basic differences in fracture morphology between Al base alloys and Mg base alloys were observed (work in progress).

(iv) Splat cooling of aluminium alloys

A few ternary alloys containing Pb have been splat cooled and were found to be supersaturated solid solutions by X-ray technique. Further work is in progress.

(v) Friction and wear characteristics of aluminium alloys

The wear characteristics of three alloys containing lead have been determined. Results are under study and further work is in progress.

(vi) Bentonites

An exhaustive study regarding the effect of industrial gases on the fundamental properties of Indian bentonites has been carried out. The work includes study of the effect of industrial gases on the crystalline structure and its relationship with bonding mechanism. For this purpose, electron diffraction studies were also carried out on both untreated and gas treated bentonites.

(vii) Refractory raw materials

Studies on expansion and sintering characteristics of several sand and refractory materials have been undertaken with a view to developing a highly refractory material with consistently low expansion characteristics. Technique for continuous measurement of expansion up to 450°C has also been developed.

(viii) Chilling in cast iron

The microstructure and mechanical properties of a casting depend mainly on the composition of the metal and the cooling rate. The use of chiller hastens the cooling of molten metal in the mould considerably due to increase in the cooling rate. The rate of cooling induced by the application of chiller depends on the chiller material, its composition, size and contact area, the chemical composition and super-heat of the cast alloy and the thermo-physical properties of the chiller and the casting.

Experiments were conducted and measurements made to obtain the instant equilibrium temperature in the case of hypoeutectic cast iron melt and chiller material. Generalised equations have been developed for the particular set of boundary conditions and a mathematical model for the chilling process has been developed.

Biochemistry

Cellulolytic microbes are being extensively studied in recent years for their potential importance in industrial saccharification. *Macrophomina phaseolina*, a phytopathogenic fungus, is known to produce extra-cellular cellulolytic enzymes, viz. endoglucanase(s), exo-glucanase(s) and β-glucosidase(s) when grown in different cellulosic media. The crude extract was found to contain β-

glucosidase, β-xylosidase, cellobiase, CMCase activity to homogeneity. *M. phaseolina* was also found to produce an extra-cellular cellobiase. Differential thermal denaturation noted during purification suggests the presence of two different activities.

Cellular and molecular biology

The localization of I-protein in liver sections has been studied with the aid of immunofluorescence techniques; it has been shown to be present predominantly on the surfaces of liver cells from adult rats and mice, but is not present on cells of embryonic liver tissue or after partial hepatectomy. It is not present either in tissues from rat kidney or spleen, indicating that it is a liver-specific protein. These observations are entirely in accord with the model proposed earlier.

A new macrophage tumour line from rats

In the course of studies with the rat *Zajdela hepatoma* tumour, a new tumour has been identified. It has been conclusively demonstrated by morphological, physiological, enzymatic and immunological criteria that the tumour is one of macrophage lineage.

Tumour antigens from a rat tumour line

A tumour specific transplantation antigen (TSTA) from a rat ascitic hepatoma (Zajdela ascitic hepatoma, ZAH) with a molecular weight of 110 kilo-daltons has been purified to homogeneity. The antigen provides partial protection against subsequent challenge with cells of the same tumour line. The method used in the isolation is generally applicable to other TSTAs.

Malaria parasite monitored by photoacoustic spectroscopy (PAS)

PAS has been used as *in situ* probe to study the pathway of hemoglobin degradation and 'hemozoin' production by the malaria parasite (Plasmodium) within the red blood cell. This study has provided insight into the mechanism of therapeutic action of the hydroxyquinoline class of antimalarial drugs (such as chloroquine); the results support the model that hemin released upon degradation of hemoglobin forms a complex with chloroquine, and that this complex is responsible for parasite cell lysis. The study has also served to elucidate at least one method by which a parasite may become resistant to this important group of antimalarial agents.

Ribonucleases (RNases)

RNases from a variety of sources have been isolated and studied. An RNase from bovine seminal plasma, termed RNase BSD, that had been purified in a single step by DNA: cellulose affinity chromatography, was shown to be

identical to RNase BS-1, isolated earlier from the same source by Italian workers by different methods. An RNase from cobra venom has been isolated using a DNA affinity column and has been partially characterized. An RNase of high subunit molecular weight (93,000 daltons) was purified to homogeneity from human milk plasma; this preparation spontaneoulsy gave rise to smaller molecular weight species of the enzyme upon storage to 4°C that still retained catalytic activity. A membrane associated RNase activity has been detected in bull spermatozoa and is being studied further. Work is in progress towards the purification by HPLC of an RNase with interesting substrate specificity from rat liver cells, with a view to determining whether it might represent a novel class of "restriction RNase".

Transfer of proteins across membranes

The synthesis of signal peptide sequence of chicken egg lysozyme had been achieved earlier as part of a study undertaken to understand the mechanism by which proteins interact with, and are translocated across, biological membranes. The interaction of the signal sequence, as well as of fragments of it, with model membranes has been studied in some detail with the aid of fluorescence spectroscopy. 'Modified' signal sequences of chicken lysozyme have been synthesized, with the incorporation of specific amino acid alterations at defined positions. The effects of these changes on membrane interaction properties are being studied. The synthesis of the signal sequence of another secreted protein, *E. coli* lipoprotein, for use in similar studies is nearing completion.

Studies on protein refolding

The pathway by which a fully denatured protein folds back into its native folded conformation has been studied in respect of two proteins, papain and human carbonic anhydrase B(HCAB), with the aid of circular dichroism, fluorescence and optical absorption spectroscopy. The results with papain were suggestive of the possibility of an intermediate in the refolding process but were not conclusive. The results obtained with HCAB, on the other hand, clearly implicate the presence of a quasi-stable non-functional folding intermediate that has been referred to as the 'molten globule' state, with essentially the same secondary structural features as the native enzyme, but with a different arrangement of the side chains in the tertiary folding.

Theoretical studies and mathematical models in biology

Studies on protein folding have been carried out by determining potentials for pairs of amino acids in the four different secondary structures possible in a protein. These calculations have shown that all secondary structures in a protein are not inherently "derivable" from the primary structure; these

findings have called into question the traditional hierarchical concept of "secondary first and tertiary later" in the folding of a protein to its native state.

Chemical Biology

Hormones: Biogenesis, regulation and mode of action

(a) Extrathyroidal thyroxine

The biological significance of the extrathyroidal peroxidases and the impossible modulator has been investigated. A highly active peroxidase has been isolated from submaxillary gland which can iodinate a protein isolated from the same source to form thyroid hormones. This enzyme has been shown to be controlled by the thyroid hormones. A membrane-bound peroxidase has been isolated from stomach which is modulated by chloride ion. The enzyme was found to be regulated by glucocorticoids which control the enzyme synthesis by affecting the translational step of protein synthesis. Possible function of this enzyme in gastric acid secretion is now under investigation. A remarkable observation has recently been made in connection with the control of uterine peroxidase. Submaxillary gland possibly contains a factor which controls the uterine peroxidase activity by modulating the synthesis of the estrogen from ovary.

(b) Erythropoietin

The role of erythropoietin in lipid biogenesis of RBC membrane has been demonstrated. It has been shown to stimulate acetate incorporation into lipids and to alter the lipid composition of red cell membrane, indicating a new biological role of the hormone.

Molecular biology and genetics of Vibrio cholerae

Genes involved in repair of DNA damage have been analyzed from studies on wild type and mutant cells. Mutants have been isolated, gene transfer by transfection has been demonstrated and the enzymes have been examined in detail. All these studies, besides helping to develop an expanded linkage map, also revealed a correlation between pathogenicity and several metabolic functions. This observation was further extended to isolate nontoxinogenic mutants of hypertoxinogenic strains by a relatively simple screening procedure. In addition, the choleraphage 149 genome and *in vivo* synthesis of phage specific proteins have been worked out in detail.

Enzyme immunoassays

Enzyme immunoassay techniques were adapted for the assay of proteins and

peptide hormones, such as myoglobin and human chorionic gonadotropin (HCG) by ELISA (enzyme-linked immuno-sorbent assays) and of haptens, such as estriol and diosgenin by EMIT (homogeneous enzyme immunoassays).

Neurobiology

(i) Biochemistry of brain cells

Protoplasmic astrocytes, which represent the bulk of the glial cells in brain, have been characterized and purified. The isolation of these cells represents the first report on the isolation of a subclass, i.e. an individual type of brain cell, and is of great potential importance in defining various neurological diseases, including tumours, viral encephalitis and those related to the release of neurotransmitters and hormones at the cellular level.

(ii) Studies on neurotransmitters

It has been demonstrated that MAG types can be selectively inhibited to the brains of laboratory animals, so that they can be used as models for neuropharmacological and psycho-pharmacological studies. There is evidence which suggests that MAO type A plays a more significant role in drug induced depression, stereotype, catalepsy, etc.

(iii) Neurological disorders

Further investigations on the genesis of Parkinson's disease have revealed that a disbalance between motor output and recurrent inhibition in the spinal cord and a defective bias on muscle spindle different discharges can be implicated in the genesis of tremor, an important feature of Parkinson's disease. The role of motoneurons in tremorogenesis was elucidated through biochemical confirmation of Renshaw cell inhibition.

Chemistry of natural products

Total synthesis of (±) and optically active (l)-vincatine, a unique indole alkaloid, has been achieved. This, the only successful synthesis of this alkaloid, has at the same time confirmed the suggested structure and the relative and absolute stereochemistry of the compound. Solanocapsine isolated from *Solanum pseudocapsicum* has been converted to solanogantine for pharmacological evaluation. Preliminary investigation has shown that solanogantine possesses promising hypotensive, tranquillizing and antiinflammatory properties.

Reproductive biology

(a) Role of dead embryos in corpus luteal function

Functional status of corpus luteum in terms of progesterone secretion in both pseudopregnant and pregnant rats is identical before establishment of placental luteotropic function. But it is an unresolved question whether the presence of dead embryos in the uterine lumen has any influence on corpus luteal function. This situation is entirely different from pregnant or pseudopregnant state, because dead embryo is recognised by the uterus as an unwanted mass, and unwanted bodies like intra-uterine devices (IUDs) have been shown to induce luteolysis. The present endeavour reveals that dead embryo produced a significant fall in progesterone through luteolysis. Luteolytic factors from the dead embryo-bearing horn act locally on the adjacent ovary.

(b) Sperm-maturation studies

Neutral epididymal alpha-mannosidases and cyclic AMP-dependent protein kinases and testicular phosphoprotein phosphatases have been partially purified and characterized. Ecto-ATPase and protein kinase activities have been demonstrated in rat epididymal spermatozoa.

Botany

Blue-green algae (*Cyanobacteria*): *Genetic regulation of heterocyst differentiation and nitrogen fixation*

Physiological principles and genetic elements regulating heterocyst differentiation and nitrogen fixation were studied in *Nostoc muscorum* Ag. and *Nodularia harveyana* (Thw) Thur. Response of several L-isomers of amino acids and their analogues on heterocyst differentiation under different experimental conditions showed that glutamine, glutamate, methionine and histidine (0.5-2.0 mM) completely suppressed the heterocyst development, while tryptophan, lysine, alanine, aspartate, arginine, serine and phenylalanine (0.5-2.0 mM) either delayed or partially suppressed the heterocyst development. Supplementation of L-methionine sulfone (10-20 μM) and DL-methionine-DL-sulfoximine (MSO), a structural analogue of glutamate (5-10 M) depressed heterocyst differentiation in the presence of combined nitrogen sources, but addition of glutamine, glutamate and methionine blocked heterocyst development. Treatment with 7-azatryptophan (5-10 μM), β-2-thienylalanine (20 μM) and rifampicin (1-2 μg) was also investigated.

Cellular differentiation of life cycle of *Nodularia herveyana* was fully investigated.

The survival of *Nostoc* with nitrosoguanidine (100 μg) showed sigmoidal pattern up to 60 min of treatment and then followed an exponential inactivation. For mutagenic treatment, NTG (200 μg) was selected and mutagenized cultures, after segregation, were screened for mutant of different markers (Net Nif, Het Nif$^-$, resistant to MSO, methylamine, azide, 8-azaguanine and drugs, and defective in nitrate-nitrite reductase and glutamine synthetase).

With heat treatment (60°-70°C), *Nodularia* produced a short-trichome, non-sporulating, non-mucilaginous (st$^+$aki$^-$mus$^-$) strain.

Lichens

Studies on the genus *Parmentaria* revealed the existence of two new species from South India, *P. oligocarpon* A. Singh and *P. pluricarps* A Singh.

Under the second part of studies on the genus *Anthracothecium* from 24-Parganas district, West Bengal, four species, *A. liucostomum* (Ach.) Malme, *A. ochracoflavum* (Nyl.) Mull. Arg and *A. semiundum* Mull. Arg., were reported from the area, including a new species *A bengalensa* A Singh, bringing the total number of *Anthracothecium* spp. from that area to seven. *A. ochracoflavum* and *A. semiundum* are new records for India.

Costus speciosus (Koen.) Sims.

Chemical examination of the non-saponifiable portion of the hexane extract of the seeds has resulted in the isolation of eight compounds. Out of these, two steroidal compounds were identified earlier. Among the rest of the six compounds, five were quinones. One quinone was known and identified as α-tocopherolquinone. The structure of four new quinones was established as dihydrophytylplastoquinone, 6-methyldihydrophytylplastoquinone, α-tocopherolquinone acetate and 2,3,6-trimethyl-5-(2-acetyl) isopentyl-benzoquinone.

The seeds appear to be a good source for tocopherols, as appreciable quantity of ξ-2-tocopherol was isolated and identified.

Echinops echinatus Roxb.

The constituents of *Echinops echinatus*, *n*-hentriacontane, *n*-hentriacontanol, β-sitosterol, β-sitosterol-β-D-glucoside, lupeol, lupeol acetate and ursolic acid have been characterised by spectral and chemical means.

Panax pseudo-ginseng Wall.

Saponin and non-saponin fractions of the rhizomes of the plant were separated earlier. The non-saponin fraction was found to contain twelve compounds. Of these, two compounds were new and were characterised as detriacontanyl palmitate and 14-hydroxyheneicosanoic acid. Eight compounds were known

and identified as pentatriacontane, triacontanoic acid, methyl palmitate, palmitic acid, stearic acid, eicosanoic acid, hexatriacontanoic acid and β-sitosterol.

Rauvolfia canescens L.
The total alkaloids of the roots were fractionated into weakly basic and strongly basic fractions. The weakly basic fraction of the compound has been identified as ajmalicine.

Solanum verbascifolium L.
Five crystalline compounds have been isolated. The structures of four of these compounds have been established on the basis of chemical and physical methods as 2,3-dimethylhentriacontane, triacontanol, β-sitosterol and triacontanoic acid.

Soymida febrifuga A. Juss.
Three new tetranortriterpenoids have been isolated from the fruits. The structure of one new compound was assigned earlier as epoxyfebrinin B. The structure of the second new compound has now been assigned as 14,15-dihydroepoxyfebrinin B by ^{1}H NMR, ^{13}C NMR and mass spectral data.

Fifteen species of Cymbopogon were investigated by chromosome number and detailed karyomorphology. Eleven species (including *C. caesius*, *C. winterianus*, *C. martinii* var. *motia*, *C. flexuosus*, *C. pendulus*, *C. jawarankusha* and other affiliated species) have $2n = 20$; three species (*C. martinii* var. *Sofia*. *C. nardus* and a species affiliated to *C. flexuosus*) are with $2n = 40$ and one (*C. citratus*) has $2n = 60$ chromosomes.

A number of phytopathogenic and saprophytic bacteria, isolated from various sources, were tested against *Drechslera victoriae* (Meehan & Morphy) Subram *et* Jain, causing leaf spot disease of lemongrass. The results showed that these saprophytic bacteria could inhibit the growth of the pathogen *in vitro*.

The oils of *Bursera delpechiana*, *Cedrus deodara*, *Clociumum* sp., *Cymbopogon martinii* var. *motia*, *Pelargonium roseus*, *Schinus molle* and *Seqoiadendron giganteum* exhibited fungicidal action, while *Hyssopus officinalis*, *Juniperus pseudosabina* and *Origanum vulgare* exhibited fungistatic action. The rest of the oils showed partial or poor fungitoxicity.

Detailed investigation on the oil of *Schinus molle* has been concluded. It exhibited absolute toxicity against 5 fungi out of 16 human pathogens tested and was found more active than Multifungin, a synthetic lotion used to cure dermal infection.

Thirty three oils have been tested using poisoned food technique against common storage fungi, viz. *Alternaria alternata*, *Aspergillus flavus* and

Penicillium italicum. The oils extracted from *Cymbopogon winterianus*, *Pelargonium roseum* and *Trachyspermum ammi* exhibited fungistatic action. The remaining oils showed partial or poor fungitoxicity.

Drugs and Pharmaceuticals

Clinical trial of the oral contraceptive Centrochroman at 30 mg weekly dose was continued at different centres in U.P. The cumulative duration of use till now is 455 months (4077 menstrual cycles) and the pregnancy rate at 12 months has been found to be 0.59 per 100 users. Life table analysis shows acceptable degree of pregnancy protection. In a study of the metabolism of the compound, it was found to be metabolised by rat liver homogenate *in vitro*, one of the metabolites being 2,2-dimethyl-4-(*p*-hydroxyphenyl)-4-[*p*-(β-pyrrolidonoethoxy)phenyl]-7-methoxychroman.

Centchroman is also under trial for treatment of breast cancer in subjects who do not respond to other methods of therapy. Eight more patients have completed the trial in 60 mg tri-weekly regime, bringing the total to 32; more than 50 per cent cases responded to treatment. Optimum response was obtained in 3-6 weeks and duration of remission was 1.5-6 months.

Clinical trial of the new local anaesthetic Centbucridine for intravenous regional anaesthesia has been completed in 60 patients requiring limb surgery; at a concentration of 0.35 per cent, the compound was found to produce adequate anaesthesia with low incidence of side-effects.

A new synthetic compound (74/75), when inserted in the form of a gelatin capsule into the fallopian tube of female monkey, caused occlusion of the tube.

A quinine-resistant strain of *Plasmodium berghei* selected in Swiss mice showed decrease in sensitivity to mefloquine also, but its sensitivity to chloroquine, amodiaquine and primaquine remained unchanged. A strain of *P. berghei* resistant to a combination of mefloquine and quinine has also been selected in Swiss mice. This would point to the possibility of development of strains of a malaria parasite resistant to both mefloquine and quinine under field conditions.

Midecamycin, a new macrocyclic antibiotic, was found to decrease the mean survival time of mice infected with *P.y. nigeriensis* significantly. Since this parasite has innate resistance to chloroquine, ecamycin may be of use in areas where *Plasmodium falciparum* has become resistant to chloroquine.

After infection of male mastomys with *P. berghei*, three distinct peaks of gametocytaemia were observed, compared to only two peaks in infected female animals. Gametocytes of the first peak showed maximum infectivity to mosquitoes as judged from the number of oocysts developed in the gut of the insects.

In a continuing study of the sero-epidemiology of malaria, by IHA test, using the *Plasmodium knowlesi* antigen prepared earlier, it has been found possible to differentiate between old and newly acquired infections.

It has been possible to establish Shephard's foot pad model of *Mycobacterium leprae* infection in Swiss mice and CBA mice. After inoculation of live *M. leprae* into the foot pad of mastomys 1000 times, multiplication of the organism was seen and this model can be used for studies on leprosy.

Subdermal inplant of rifampicin in guineapigs infected with *Mycobacterium tuberculosis* H37RV was found to arrest the progress of the infection.

A new analogue of metenkephalin (compound 83/205) was found to be 15 times as active as morphine as an analgesic and is also active by systemic route.

Industrial Toxicology

Toxicity of metals

Development toxicity of perinatal exposure to low doses of cadmium was investigated in female rats exposed to low doses of Cd^{2+}. Perinatal exposure to Cd^{2+} appeared to cause certain developmental toxic effects, which might result in long-term behavioral aberrations.

An animal model using liver regeneration was developed to study the action of toxic metals on the target tissue of growing biological systems for extrapolating the risk of exposure of metals to human subjects. Ionophores are being synthesised in view of their cavity size to match with the ionic radii of heavy metal ions to facilitate their selective removal from the biological system.

Environmental phototoxicology

Capabilities for evaluation of phototoxicity of environmental chemicals were developed, since the influence of sunlight and other reactions on toxicity is of vital importance in India. Among various pesticides tested, only Zineb induced the production of singlet oxygen and superoxide anion to an extent considered to be phototoxic to cellular system. Riboflavin (vitamin B_2) was found to produce activated cytotoxic oxygen species, including singlet oxygen to cause photodynamic oxidative degradation of guanine, thymine bases of nucleic acids and various sulphur containing and heterocyclic amino acids *in vitro*. The damages to (i) calf thymus DNA, and (ii) paramecium species, upon combined exposures to various doses of sunlight and riboflavin, were developed as models for phototoxicity studies.

Pesticides

Daily oral administration of 22 different pesticides and their formulations to male rats at low levels for a period of 5 days indicated varied changes in mitotic stages in the bone marrow of animals. Majority of pesticides evaluated had produced chromatid breaks and indicated their action at S or G_2 phase of the cell cycle.

LD_{50} values of endosulfan and malathion were investigated in earthworms and toxicity established by pathomorphological, biochemical and interstructural studies. Studies conducted on the effect of a synthetic pyrethroid Decis suggested that the insecticide may cause chromosomal damage, which in turn may cause mutation.

GENERAL

Smt. Indira Gandhi, Prime Minister and President, CSIR, inaugurated the 33rd Conference of Directors of the national laboratories of CSIR held in New Delhi during 27-28 June 1983.

The Society of CSIR met on 13 April 1983 and 18 January 1984 under the chairpersonship of the Prime Minister.

Four meetings of the Governing Body, CSIR, were held on 28 June, 21 November, 14 December 1983 and 2 January 1984. The Governing Body of CSIR has been re-constituted for a period of two years from 9 November 1983.

The Planning Division of the CSIR Headquarters undertook the task of formulation of CSIR Annual Plan 1984-85. The Division convened meetings of expert groups of national laboratories and other R&D Institutions/ Departments participating in the multi-institutional programmes, for monitoring the progress and deciding on further aspects of R&D activities. Shri N. Sen, Joint Adviser in the Planning Division was nominated the Convener of the Working Group for CSIR 7th Plan set up by the Planning Commission under the chairmanship of DGSIR. The Working Group held three meetings in New Delhi: the first on 30 November 1983, the second on 19 January 1984, and the third on 16 February 1984. The Division was concerned with the formulation of the 7th Plan in two volumes, the first (as the main document) giving the broad outline and the second (in five parts) dealing with area programmes and other details. For the first time, a deliberate attempt was made to integrate, with the help of area coordinators identified from different laboratories, the individual plan proposals of national laboratories on the basis of 36 areas. The draft Plan document was submitted to the Planning Commission on 31 March 1984.

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

During the year, CSIR examined 412 applications for foreign collaboration, 1910 for industrial licences, 142 composite applications and 40 Non-Resident Indian (NRI) proposals. The Division participated in 18 FIB; 37 TEC; 25 PAB; 42 LC, MRTP; 53 LC meetings and 8 Special Approval Committee meetings to consider NRI's proposals. 129 new applications for the recognition of R&D units, 93 renewal proposals and 11 applications for delicensing of industries based on indigenous technologies were received, examined and comments communicated. The Division represented CSIR in the meetings of Screening Committee of R&D applications, Delicensing Committee, etc.

The Division has published a hand-book on "Technology for Rural Development (Vol. I)—Production-oriented & Employment Generating

Technologies". The publication aims at providing data pertaining to selected technologies developed by different CSIR laboratories, with economic and production objectives to help in production of value added products near the source; to optimise utilisation of local raw materials; to help in economic utilisation and recycling of byproducts/wastes and to project new and modern technologies for self-employment.

The Eighth Session of the Indo-Bulgarian Joint Sub-Commission on S&T was held in New Delhi during 20-25 May 1983 to review the existing programme of S&T cooperation and work out a fresh programme. The Bulgarian delegation was led by H.E. Alexander Alexandrov, Vice-President, State Committee for Science and Technical Progress, Sofia and the Indian team by Dr G.S. Sidhu, Director General, CSIR. A protocol and programme for the years 1983-85 was signed.

The Indo-ARE Joint Scientific Board meeting was held in Cairo during 30 September-5 October 1983 to review the existing S&T Programme and formulate a Work-Plan for 1983-86 on Scientific and Technical Cooperation between India and the Arab Republic of Egypt. The Indian delegation was led by Dr G.S. Sidhu, Director General, CSIR and included Dr P.K. Jena, Director, Regional Research Laboratory (Bhubaneswar), Dr S.P. Manjrekar, of the Central Food Technological Research Institute, Mysore, Dr S.S.H. Quadri of the Regional Research Laboratory, Hyderabad, Dr H.K. Mulchandani of the Indian Institute of Petroleum, Dehra Dun and Shri N.N. Joshi of CSIR. The Egyptian delegation was led by Prof. Dr I.G. Badran, President, ARE Academy of Scientific Research and Technology, Cairo.

A proposal for assistance to CEERI, Pilani under the UNDP was finalised during the year under reivew. The Project document was signed on 25 October 1983. The project ("Semi-conductor devices and electronic sub-systems for transportation") envisages UNDP assistance of US $ 14,67,000 and contribution of the Government of India to the tune of Rs 139 lakh.

Assistance to CSIR by UNDP for utilising the services of expatriate Indian Scientists and Technologists under the Project on "Transfer of Know-how through Expatriate Nationals" (TOKTEN) was extended for a further period of two years, envisaging UNDP assistance of $ 4,00,000 and Government of India's contribution of Rs 4.104 lakh.

An Indo-US collaborative project on Bio-active substances from marine organisms involving participation of NIO, CDRI and the Bose Institute, Calcutta, was approved by the Government of India.

Another Indo-US Collaborative Project on "Cold Gas Clean-up and Separation" has been approved by the Government of India involving collaboration between RRL, Hyderabad and the US Department of Energy, with US assistance of $ 60,000 and counterpart expenditure of Rs 8 lakh.

Assistance by SIDA to CRRI for traffic research was extended with a

further allocation of 4,75,000 Swedish *croners*. The National Swedish Road and Traffic Institute is the implementing agency from the Swedish side.

CFTRI is a recognised Associate Institution of the United Nations University for research and training in the field of Food Conservation under the UNU "Freedom from Hunger" Programme. The CSIR-UNU Agreement which was signed in 1977 for a period of five years has been extended for a further period of five years.

About 60 scientists from outside countries were trained in the laboratories of CSIR in various fields. Most of these trainings were organised under the sponsorship of the international agencies, such as WHO, FAO, UNIDO and UNDP. These programmes were monitored by the International Science Collaboration Unit.

The Division for Scientific and Technical Personnel (DSTP) of the CSIR Headquarters brought out 8 issues of TECHNICAL MANPOWER, 5 issues of Pool Supplement containing particulars of persons selected to the Scientists' Pool, and 4 issues of Indians Abroad Directories incorporating particulars of scientists, technologists, engineers and medical personnel with foreign qualifications/training.

Four hundred and thirtyfour persons were selected to the Scientists' Pool during the year 1983-84. Since the beginning of the operation of the Scientists' Pool Scheme in 1959, a total number of 7,179 persons joined the Pool. The number of Pool Officers working as on 31 March 1984 was 465.

A total of 391 scientific and technical personnel were registered in the Indians Abroad Register during the year. In addition, 13 social scientists and 3 business administrators were also enrolled. Brief biodata from 151 persons, many of whom are either foreign nationals of Indian origin or Indian permanent residents abroad, were also received. Biodata of 7,270 new specialists were received during the year, bringing the total registration in the Specialists' Register to 48,270 as on 31 March 1984.

During the year 1983-84, 548 research projects were supported and grants provided. About 155 new schemes were recommended for support and work on these has either commenced or is likely to commence soon. 472 Junior Research Fellows, 213 Senior Research Fellows and 52 Research Associates were sanctioned for the schemes in progress during the year to assist the Principal Investigators in their projects. About 150 research projects were completed.

The number of direct research fellows/associates as on 1 January 1984 receiving assistance from CSIR was 3127 in academic and research institutions other than CSIR laboratories. Of these, 1730 were Junior Research Fellows (JRF), 1196 were Senior/Post-doctoral Research Fellows (SRF/PDF) and 211 Research Associates. Besides, about 400 Research Fellows and 50 Associates are working in the CSIR laboratories.

GENERAL

One hundred and twenty nine (129) CSIR fellows received Ph.D. degree, one hundred and twenty four (124) fellows submitted their thesis for Ph.D. and two hundred and sixty one (261) Junior Research Fellows were promoted as Senior Fellows during the year. The total number of fellowships/associateships completed/terminated due to resignation was four hundred and sixty nine (469).

Under the scheme of travel grants to young research scholars not employed on a regular basis for presenting papers at International Conference/Seminars, etc. grants amounting to Rs 55,000 were given to ten applicants during the calendar year 1983.

Grants amounting to Rs 6.3 lakh were given to 103 learned societies/ university departments for organisation of symposia/seminars during the calendar year 1983.

Grants were given to 18 Indian language periodicals primarily devoted to popularisation of science through Indian languages. Of these, four each were in Malayalam and Bengali, two each in Tamil, Hindi and Marathi and one each in Gujarati, Assamese, Oriya and Kannada. Of these 18 journals, one journal in Bengali started getting grants from this year. The total grants for the year 1983-84 amounted to Rs 1,38,000.

The Shanti Swarup Bhatnagar Prizes for Science and Technology for the year 1982 were announced. The recipients are:

Prof. Girish Saran Agarwal and Prof. T.V. Ramakrishnan;	Physical Sciences
Prof. C.L. Khetrapal and Prof. G.S.R. Subbarao;	Chemical Sciences
Dr Ramamritha Jayaraman and Dr Sunil Kumar Podder;	Biological Sciences
Prof. B.L.S. Prakasa Rao and Prof. J.B. Shukla	Mathematical Sciences
Dr Ragunath Anant Mashelkar;	Engineering Sciences
Dr Kunchithapadam Gopalan	Earth Sciences

No award was announced in Medical Sciences for the year 1982.

The Public Relations Unit (PRU) organised a seminar on 'Science in the Media' on 27 and 28 September 1983, bringing together scientists from national laboratories and media representatives to discuss problems pertaining to popularisation of science and evolve guidelines for greater and co-ordinated interaction between information units of the national laboratories and CSIR HQs. CSIR participated in the India International Trade Fair 1983 (14-27 November 1983) along with other science departments. PRU coordinated the participation.

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 1983 to March 1984, the Project Officers of PTCs visited/revisited nearly 1500 industrial units and identified about 1100 technological problems; about 950 technical solutions were provided. The PTCs attended to more than 2300 technical and general enquiries from entrepreneurs, associations of industries and other interested parties.

HONOURS & AWARDS

Dr R.A. Mashelkar of NCL, Pune, has been awarded the 'Shanti Swarup Bhatnagar Prize' for engineering sciences for the year 1982.

Dr S.C. Pakrashi of IICB, Calcutta, has been elected a Fellow of the Indian National Science Academy, New Delhi.

Dr R.A. Mashelkar of NCL has been elected a Fellow of the Indian Academy of Sciences, Bangalore. He has also been elected a Fellow of the Indian National Science Academy, New Delhi.

Dr G. Thyagarajan, Director, RRL, Hyderabad, was awarded the K.G. Naik Gold Medal for 1981 for contribution to the published research which has found or is most likely to find application in developing Indian industries during 1976-81.

Dr A.V. Rama Rao of NCL, Pune, has been awarded the K.G. Naik Gold Medal of M.S. University of Baroda for the year 1982 for his contributions in the field of organic chemistry.

Dr R.A. Mashelkar of NCL, Pune has been awarded the inaugural 'Prof. M. Santappa Silver Jubilee Award' in recognition of his contributions to polymer science.

Dr H.K. Gupta, of NGRI, Hyderabad (on deputation to the Centre for Earth Science Studies, Trivandrum), led the third expedition to Antarctica.

Shri H.V. Ram Babu of NGRI, Hyderabad, was awarded the 1983 Young Scientists Medal of the Indian National Science Academy for his contribution to the development of techniques for the interpretation of magnetic gravity and self-potential anomalies.

Prof. D. Balasubramanian of CCMB, Hyderabad, has been elected Fellow of the National Academy of Sciences (1983) and awarded the P.S. Sarma Memorial Award of the Society of Biological Chemists, India (1983) and the M.O.T. Iyengar Award of the Indian Council of Medical Research (1983).

Dr M.R. Das of CCMB, Hyderabad, has been elected Fellow of the National Academy of Sciences (1983) and awarded the Hari Om Ashram Alembic Award for basic research in Medical Sciences (1983).

Dr A.P. Mitra, Director, NPL, New Delhi, was nominated the Chairman and Dr B.S. Mathur, NPL, the Convenor of the Local Organizing Committee of the Ninteenth General Assembly of the International Astronomical Union to be held in New Delhi during 19-28 November 1985.

Dr Krishan Lal of NPL, New Delhi, was elected Fellow of the Indian National Science Academy, New Delhi for the year 1983.

Dr Ved Ram Singh of NPL, New Delhi, received the ICMR Award (Shakuntala Amir Chand Prize), for 1983 for his work on bio-medical transducer devices for use in basic and clinical research.

Prof. P.K. Rohatgi, Director, RRL, Bhopal, received the Binani Gold Medal from the Indian Institute of Metals for his paper on 'Energy Analysis of

Aluminium Extraction'. He also received the Distinguished Alumnus Award from the Department of Metallurgy, Banaras Hindu University, Varanasi.

Prof. A. Rahman, Director, NISTADS, New Delhi was elected Vice-President of the Research Committee on Science and Politics of the International Political Science Association (Belgium).

Dr B. Singh, Director, CMRS, Dhanbad, has been elected President of newly formed Society known as Indian Society of Rock Mechanics and Ground Control.

Dr K.S.Rajagopalan, Director, CECRI, Karaikudi, received the FICCI Award for 1983 for his contributions to corrosion and its control.

Dr Anand Akhila of CIMAP, Lucknow, has been elected Fellow of the Institution of Chemists (India).

Dr A.G. Mathew, Acting Director, RRL, Trivandrum, has been elected President, Essential Oils Association of India.

STATISTICAL TABLES

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
FINANCIAL DATA

(Rs in lakhs)

Particulars	Actual Expenditure for 1981-82			Actual Expenditure for 1982-83			Actual Expenditure for 1983-84		
	Non-Plan	Plan	Total	Non-Plan	Plan	Total	Non-Plan	Plan	Total
1 Central Administration									
(i) Pay & Allowances, Contingencies, Maintenance	150.624	12.543	163.167	180.930	7.953	188.883	200.899	11.334	212.233
(ii) Headquarters Technical Activities	6.270	12.557	18.827	7.288	15.181	22.469	19.636	9.327	28.963
(iii) Miscellaneous Pension, Advances etc.	382.557	20.397	402.954	532.278	36.054	568.332	497.945	29.870	527.815
Total Central Administration	539.451	45.497	584.948	720.496	59.188	779.684	718.480	50.531	769.011
2 Laboratories	4052.657	2986.170	7038.827	4621.498	3496.119	8117.617	5123.685	3881.169	9004.854
3 Scientists' Pool	42.717	—	42.717	64.315	—	64.315	92.650	—	92.650
4 Research Schemes, Scholarship and Fellowships	—	488.508	488.509	—	590.747	590.747	—	613.030	613.030
5 Industrial Research Associations	59.045	14.420	73.465	53.490	31.128	84.618	54.330	32.690	87.020
6 Pilot Plants	65.932	—	65.932	85.070	—	85.070	123.878	—	123.878
7 Residential Buildings	58.533	219.033	277.566	64.262	373.107	437.369	73.065	442.070	515.135
Grand Total:	4818.335	3753.628	8571.963	5609.131	4550.289	10159.420	6186.088	5019.490	11205.578

NON-PLAN—SUB-HEADWISE BREAKUP OF ACTUALS FOR THE YEAR 1983-84

(Rs in lakhs)

	RECURRING							CAPITAL					Grand Total
Labs/Institutes	P1-Pay of officers	P2-Pay of Estab.	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	Rec + Capital
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I. Physical Science Group													
NPL	40.750	45.781	130.040	33.070	7.000	32.850	289.491	10.130	9.000	—	0.369	19.499	308.990
CEERI	17.060	21.760	48.000	61.000	2.500	16.000	166.260	4.997	2.220	—	0.780	7.997	174.257
CSIO	18.200	26.800	72.500	19.749	2.485	24.500	164.234	3.000	2.675	—	—	5.675	169.909
NGRI	18.000	23.800	71.270	18.390	1.803	31.267	164.530	2.800	3.652	—	1.148	7.600	172.130
NIO	10.856	14.100	37.797	10.913	1.967	89.733	165.366	4.336	—	—	0.864	5.200	170.566
Total I	104.806	132.241	359.607	143.122	15.755	194.350	949.881	25.263	17.547	—	3.161	45.971	995.852
II. Chemical Sciences Group													
NCL	40.170	37.080	108.054	43.500	3.500	35.000	267.304	15.000	16.992	2.500	—	34.492	301.796
CECRI	18.360	25.870	62.194	12.930	1.004	21.520	141.878	3.237	0.001	—	(−)0.015	3.223	145.101
CSMCRI	13.630	13.140	39.140	5.461	3.871	10.360	85.602	5.000	—	—	0.238	5.238	90.840
RRL, Hyd.	32.200	36.890	107.320	23.000	2.500	30.000	231.910	6.250	—	—	—	6.250	238.160
RRL, Jorhat	14.550	17.130	48.850	8.565	1.779	10.980	101.854	5.000	—	—	1.085	6.085	107.939
CFRI	49.750	48.460	134.500	22.000	2.994	15.000	272.704	2.515	—	—	—	2.515	275.219
IIP	23.701	23.515	71.462	18.179	2.244	17.500	156.601	5.998	—	—	0.783	6.781	163.382
Total II	192.361	202.085	571.520	135.635	17.892	140.360	1257.853	43.000	16.993	2.500	2.091	64.584	1322.437
III. Engineering Sciences Group													
NML	34.550	36.104	102.286	24.250	1.701	12.500	211.391	5.500	1.741	—	0.712	7.953	219.344
CGCRI	14.890	23.600	66.750	11.500	1.700	13.000	131.440	3.496	0.794	0.130	—	4.420	135.860
CMRS	22.927	15.343	49.500	10.346	1.735	4.892	104.743	2.991	—	—	—	2.991	107.734
NEERI	14.090	20.510	60.900	10.500	1.456	10.230	117.686	2.196	—	—	1.943	4.139	121.825
RRL, Bhub.	10.215	8.510	25.169	11.672	2.100	10.433	68.099	4.998	—	—	—	4.998	73.097
CMERI	33.439	37.550	94.132	19.080	4.673	12.776	201.650	4.184	—	—	0.005	4.189	205.839
NAL	39.790	36.300	120.200	33.200	2.904	36.600	268.894	14.300	2.269	—	(−)0.004	16.565	285.559
NTAF	3.460	5.323	13.116	—	—	14.600	36.499	—	—	—	—	—	36.499
SERC, Roorkee	4.950	4.850	13.490	3.150	0.550	4.410	31.400	1.182	—	—	0.837	2.019	33.419
SERC, Madras	5.930	3.420	17.380	4.200	—	7.880	38.810	2.500	—	—	—	2.500	41.310
CSIR Madras Complex	0.780	3.993	9.094	5.213	1.432	—	20.512	0.100	—	—	—	0.100	20.612
RRL, Trivan	1.490	1.580	7.800	2.200	0.249	0.497	13.816	1.000	—	—	0.002	1.003	14.819
CRRI	13.331	15.757	44.822	11.550	0.903	4.050	90.413	3.111	—	—	—	3.111	93.524
CBRI	21.397	20.330	56.198	7.198	0.840	10.297	116.260	1.380	—		0.762	2.147	118.402
Total III	221.239	233.170	680.837	154.059	20.243	142.165	1451.713	46.938	4.804	0.130	4.257	56.129	1507.842
IV. Biological Sciences Group													
CFTRI	33.855	31.828	94.677	21.740	5.456	21.550	209.106	6.500	—	—	0.099	6.599	215.705
CDRI	29.160	27.650	92.750	30.230	7.350	40.000	227.140	8.498	9.802	0.488	—	16.788	245.928
CLRI	18.330	21.019	63.765	15.000	1.598	12.990	132.702	4.000	—	—	—	4.000	136.702
NBRI	11.600	20.830	53.490	9.500	1.100	13.650	110.170	3.700	—	—	—	3.700	113.870
BRI	11.600	20.830	53.490	9.500	1.100	13.650	110.170	3.700	—	—	—	3.700	113.870
IICB	7.100	10.580	30.500	4.950	0.660	6.950	60.740	7.000	2.850	—	—	9.850	70.590
RRL, Jammu	15.000	19.000	53.950	13.450	1.500	27.340	130.240	5.075	0.125	—	1.000	8.200	136.440
CIMAP	4.380	6.590	27.626	11.500	1.000	10.500	61.596	5.000	—	—	—	5.000	66.596
ITRC	8.200	9.000	28.800	6.850	1.002	11.500	65.352	3.695	—	—	—	3.695	69.047
CCMB	1.430	1.430	6.200	2.660	1.000	6.300	19.020	2.750	10.000	—	—	12.750	31.770
D.R.L.	—	—	14.950	—	—	—	14.950	—	—	—	—	—	14.950
Total IV	129.055	147.927	466.708	115.880	20.666	150.780	1031.016	46.218	22.777	0.488	1.099	70.582	1101.598
V. Information Sciences Group													
INSDOC	11.841	11.578	33.023	13.682	0.926	9.000	80.050	12.000	—	—	—	12.000	92.050
PID	10.900	9.740	30.700	12.925	3.341	35.000	102.606	1.300	—	—	—	1.300	103.906
Total V	22.741	21.318	63.723	26.607	4.267	44.000	182.656	13.300	—	—	—	13.300	195.956
Grand Total	670.202	736.741	2142.395	573.303	78.823	671.655	4873.119	174.719	62.121	3.118	10.608	250.566	5123.685

PLAN—SUB-HEADWISE BREAKUP OF

Labs./Instts.	RECURRING						
	P1	P2	P3	P4	P6	P7	Total Rec
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I. Physical Sciences Group							
NPL	13.389	—	21.889	16.626	—	9.097	61.001
CEERI	9.778	0.358	15.780	8.997	—	36.317	71.230
CSIO	9.852	2.660	10.468	—	—	6.498	29.478
NGRI	7.016	2.084	6.857	8.077	—	2.557	26.591
NIO	13.762	2.485	25.023	13.210	—	66.468	120.948
Total I	53.797	7.587	80.017	46.910	—	120.937	309.248
II. Chemical Sciences Group							
NCL	9.449	4.396	21.062	—	—	10.378	45.285
CECRI	5.000	0.802	6.000	2.006	—	7.794	21.602
CSMCRI	3.113	1.886	4.153	6.217	—	7.687	23.056
RRL, Hyd.	14.619	4.068	20.365	19.197	—	21.750	79.999
RRL, Jorhat	8.284	1.345	8.276	3.137	—	15.811	36.853
CFRI	0.061	0.271	1.629	4.655	—	1.178	7.794
IIP	7.286	0.239	11.852	—	—	4.003	23.380
Total II	47.812	13.007	73.337	35.212	—	68.601	237.969
III. Engineering Sciences Group							
NML	1.650	0.021	7.207	2.906	—	1.942	13.726
CGCRI	5.972	1.109	7.175	5.186	0.158	11.387	30.987
CMRS	4.323	0.009	11.637	2.500	—	—	18.469
NEERI	5.841	2.826	0.400	7.725	—	4.242	21.034
RRL, Bhub.	4.586	—	7.447	0.491	—	9.943	22.467
CMERI	3.664	0.321	8.565	—	—	3.164	15.714
NAL	8.970	1.455	9.295	1.508	—	6.076	27.304
NTAF	1.101	—	—	—	—	14.967	16.068
SERC(R)	0.762	0.075	1.673	0.249	—	1.440	4.199
SERC(M)	6.379	1.987	6.504	3.500	—	7.420	25.790
CSIR Mádras Comp.	—	—	—	—	—	—	—
RRL, Triv.	4.773	5.318	12.808	2.499	—	4.599	29.997
RRL, Bhopal	2.607	1.779	4.307	7.569	0.215	2.729	19.206
CRRI	2.730	2.151	7.942	2.634	—	1.190	16.647
CBRI	5.725	—	8.477	4.000	—	—	18.202
Total III	59.083	17.051	93.437	40.767	0.373	69.099	279.810
IV. Biological Sciences Group							
CFTRI	8.117	—	5.883	—	—	12.000	26.000
CDRI	8.072	0.802	2.971	9.385	0.751	15.365	37.346
CLRI	5.556	—	3.187	0.990	—	—	9.733
NBRI	4.392	0.380	6.035	3.110	—	6.979	20.896
IICB	7.017	0.251	10.452	7.495	—	26.713	51.928
CFB	2.504	2.819	9.298	4.846	1.310	9.394	30.171
CSIR Complex, Palampur	—	0.016	0.206	1.205	0.001	0.365	1.793
RRL, Jammu	6.920	0.515	6.499	5.000	—	17.265	36.199
CIMAP	5.202	4.458	4.940	7.030	—	6.838	28.468
ITRC	2.346	0.250	6.716	5.274	—	11.576	26.162
CCMB	6.084	1.708	13.870	10.690	—	29.433	61.785
IMT	1.074	0.305	4.800	8.000	0.250	3.081	17.510
Total IV	57.284	11.504	74.857	63.025	2.312	139.009	347.991
V. Information Sciences Group							
INSDOC	3.400	—	5.200	2.936	—	15.462	26.998
PID	4.244	1.710	5.873	1.078	—	12.489	25.394
NISTADS	6.125	1.476	11.546	9.783	—	5.647	34.577
Total V	13.769	3.186	22.619	13.797	—	33.598	86.969
Grand Total I-V	231.745	52.335	344.267	199.711	2.685	431.244	1261.987

ACTUAL EXPENDITURE FOR 1983-84

(Rs in lakhs)

CAPITAL

PS(1) Works	PS(2) Services	PS(3) App. & Equpt.	PS(4) (i) Furn.	PS(4) (ii) Lib. Books	PS(4) (iii) Vehicles	PS(4) (v) Misc Models & Exhi-	Total Capital	Total Rec + Capital
(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
13.168	7.927	111.204	1.930	1.700	—	—	135.929	196.930
2.499	7.785	140.789	0.525	—	—	0.050	151.648	222.878
5.470	0.133	32.619	0.995	—	0.844	—	40.061	69.539
7.285	9.535	87.385	1.899	0.837	—	0.070	107.011	133.602
10.259	5.914	101.940	5.930	4.809	—	0.318	129.170	250.118
38.681	31.294	473.937	11.279	7.346	0.844	0.438	563.819	873.067
16.000	15.500	98.801	—	2.000	—	—	132.301	177.586
21.262	7.818	23.165	0.473	—	—	0.073	52.791	74.393
1.830	4.096	20.950	1.487	—	—	—	28.363	51.419
24.000	7.482	51.030	3.800	—	—	—	86.312	166.311
30.147	19.980	45.723	1.219	3.123	1.190	0.496	101.878	138.731
3.895	6.295	25.785	2.303	—	—	—	38.278	46.072
2.569	4.010	30.607	0.897	—	—	0.123	38.206	61.586
99.703	65.181	296.061	10.179	5.123	1.190	0.692	478.129	716.098
2.144	1.527	21.521	0.055	—	—	—	25.247	38.973
15.294	2.621	37.480	1.403	—	—	—	56.798	87.785
9.112	4.880	29.602	3.386	—	—	0.100	46.080	64.549
14.985	2.105	30.196	0.994	—	—	0.038	48.318	69.352
8.277	2.039	47.001	1.266	—	—	0.048	58.631	81.098
2.606	(−)0.186	18.477	0.801	—	—	—	21.698	37.412
10.608	4.241	64.836	1.945	1.006	—	—	82.636	109.940
—	—	50.032	—	—	—	—	50.032	66.100
28.659	0.017	(−)0.011	0.147	—	—	—	28.812	33.011
—	—	56.668	1.000	—	—	0.012	57.680	83.470
50.467	13.779	0.300	0.400	—	0.584	—	65.530	65.530
1.260	0.948	17.000	1.000	3.600	—	0.050	23.858	53.855
—	2.499	33.273	1.998	2.198	2.475	—	42.443	61.649
2.535	0.544	7.891	1.117	—	—	—	12.087	28.734
3.226	0.798	9.768	0.249	—	—	—	14.041	32.243
148.173	35.812	424.034	15.761	6.804	3.059	0.248	633.891	913.701
10.185	1.891	33.240	1.479	—	—	—	46.795	72.795
9.573	7.047	25.424	1.500	—	—	—	43.544	80.890
7.964	7.552	25.869	1.399	—	—	0.010	42.794	52.527
10.606	8.836	27.090	3.001	—	1.043	—	50.576	71.472
1.645	13.253	32.881	0.624	2.016	0.872	—	51.291	103.219
—	0.189	6.311	0.255	0.058	0.829	0.050	7.692	37.863
—	—	1.959	0.197	0.005	1.042	—	3.203	4.996
5.696	7.661	49.312	1.800	0.500	0.030	—	64.999	101.198
27.743	10.409	50.250	2.438	1.500	—	—	92.340	120.808
2.474	2.909	14.234	1.864	—	0.078	—	21.559	47.721
24.791	126.470	67.555	4.000	4.250	0.748	—	227.814	289.599
44.538	14.750	107.334	2.248	5.312	—	—	174.182	191.692
145.215	200.967	441.459	20.805	13.641	4.642	0.060	826.789	1174.780
27.729	26.589	7.802	5.911	8.651	0.016	—	76.698	103.696
0.018	—	4.989	0.848	2.199	—	—	8.054	33.448
9.708	5.487	11.294	2.036	2.968	0.309	—	31.802	66.379
37.455	32.076	24.085	8.795	13.818	0.325	—	116.554	203.523
469.227	365.330	1659.576	66.819	46.732	10.060	1.438	2619.182	3881.169

APPENDIX I

PROCESSES GONE INTO PRODUCTION
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party	Nature of Licence
Products of Food Industry Including Beverages			
	CFTRI		
1	Fish meal and oil from sardine	Karnataka Iron Works, Mangalore	Non-exclusive
2	Dhal milling	Dispur Rice & Dhal Mills, Gauhati	Non-exclusive
3	Simple wheat milling	Jyoti Trading Co., Bulsar	Non-exclusive
4	Cocoa cream biscuits	Azad Food Industries, Mangalore	Non-exclusive
	RRL, JAMMU		
5	Beverages, mango pine-apple & lime	Shri Summit Fruit Products, Jammu	Non-exclusive
6	Hops processing	Mohan Goldwater Breweries, Lucknow	Non-exclusive
7	Fruit beverages	Sandip Fruit Products, Jammu	Non-exclusive
8	Mango squashes and nectar	JM Enterprises, Jammu	Non-exclusive
9	Packing of spices, pulses & atta	Shri Quasar Ali, Jammu	Non-exclusive
10	Sesame, quality upgradation	Shri Khanayalal & Co., Pune	Non-exclusive
Chemicals			
	CGCRI		
11	Sodium silicate from rice husk	Industrial Desiccants, Calcutta	Non-exclusive
	NCL		
12	Acrylic acid/acrylates from acrylonitrile	Indian Petrochemicals Corpn. Ltd, Baroda	Non-exclusive
	CECRI		
13	Electrochemical marking on metals	Metcon Engineers & Agents, Madras	Non-exclusive
14	Calcium metal	United Technical Consultant Pvt. Ltd., Calcutta	Non-exclusive
15	Potassium chlorate	Santha Chemicals Ltd., Madras	Non-exclusive
16	Anticorrosive packaging paper	Vapour Phase Inhibitor Paper Products Co., Bombay	Non-exclusive
	RRL, Bhubaneswar		
17	Extraction of tannin from plant barks	IPICOL, Bhubaneswar	Exclusive
18	Strawberry aldehyde	Rusikulya Aerochem, Berhampur	Non-exclusive

APPENDIX I

PROCESSES GONE INTO PRODUCTION—*Contd.*
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party	Nature of Licence
Drugs & Pharmaceuticals			
	CDRI		
19	D-2-Aminobutanol	Themis Chemicals Ltd., Bombay	Exclusive
	NCL		
20	Theophylline, aminophylline, and caffeine	Pefco Foundry and Chemical Ltd., Bombay	Non-exclusive
21	Vinblastine sulphate and vincristine sulphate	Govt. of Maharashtra & CIPLA, Bombay	Non-exclusive
22	Vitamin B_6	IDPL, Hyderabad	Non-exclusive
23	Quinapyramine sulphate & chloride	Chintamani Fine Chemicals, Poona	Non-exclusive
24	Diosgenin	Directorate of Cinchona & Other Medicinal Plants, West Bengal	Non-exclusive
Pesticides			
	RRL, Hyderabad		
25	Diazinon	Sudarshan Chemical Industries, Pune	Non-exclusive
Buildings & Structures			
	SERC(M)		
26	Core units, Cyclone resistant	Govt. of Tamil Nadu	Non-exclusive
Materials			
	CBRI		
27	Pre-cast linters	(1) On Shilp, Bhopal	
		(2) Kerala State Housing Board, Trivandrum	Non-exclusive
28	Clay bonded fly ash bricks	Baba Venketa Maruthi, Karim Nagar	Non-exclusive
29	L-Pan roofing	3 Parties	Non-exclusive
30	Activated lime pozzolona mixture	(1) Saphard Engineers, Lucknow	Non-exclusive
		(2) Vishvanath Industries, Indore	Non-exclusive
		(3) Kumaon Resin Industries, Haldwani	Non-exclusive
		(4) Annapurna Industries, Vijaywada	Non-exclusive

(Contd.)

APPENDIX I

PROCESSES GONE INTO PRODUCTION—*Contd.*
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party	Nature of Licence
31	Stone masonry block	11 Parties	Non-exclusive
32	RCC joists & planks	Kerala State Housing Board, Trivandrum	Non-exclusive
33	Modular bricks	Balaji Modular Bricks, Medak	Non-exclusive
34	Corrugated roofing sheets from wood wool or coir waste	(1) Aravali Enterprises, Abu Road	Non-exclusive
		(2) Venus Industries, Srivilliputtur	Non-exclusive
35	Channel units	Himachal Pradesh Housing Board, Parwanoo	Non-exclusive
	CGCRI		
36	Alumina ceramics for electrical & other energy uses	Quest Consultants & Engineers Pvt. Ltd., Calcutta	Non-exclusive
37	Glass colours/glass enamels	S.N. Glass Decorators, Firozabad	Non-exclusive
	NAL		
38	Foam sandwich FRP shelters	Bharat Electronics, Ghaziabad	Exclusive
Metallurgy			
39	Extra zinc metal powder	NALCO Metal Products Pvt. Ltd., Madurai	Non-exclusive
Machinery			
	CMERI		
40	Wool knitting machine	Raj Nirmal Sales Corporation, Ludhiana	Non-exclusive
	CMRS		
41	Modified screw type prop	4 Parties	Non-exclusive
42	Triangular Steel chock	Sree Durga Timber & Mining Stores, Burdwan	Non-exclusive
	CBRI		
43	Charging device for lime kiln	Bharat Chemicals & General Industries, Hardwar	Non-exclusive
44	Brick moulding table	Rural engineering Wing of NBO, Calcutta	Non-exclusive
	RRL-Jammu		
45	Terpentine oil fractionation	Dujodwala Resins & Terpenes Pvt. Ltd., Jammu	Non-exclusive
	RRL-Jorhat		
46	Tiny cement plant (VSK) for cement (20 TPD)	Bharat Cement Industries, Ahmedabad	Non-exclusive

APPENDIX I

PROCESSES GONE INTO PRODUCTION—*Contd.*
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party	Nature of Licence
Instruments			
	NEERI		
47	Wind direction recorder	Environmental Engineers, Inc, Nagpur	Non-exclusive
48	Wind Velocity recorder	Environmental Engineers Inc., Nagpur	Non-exclusive
	NGRI		
49	Porosimeter	Scientific and Technicals, Hyderabad	Non-exclusive
	NAL		
50	AC polarograph	Elico Pvt Ltd., Hyderabad	Non-exclusive
51	AC & DC Polarograph, Harmonic	Elico Pvt Ltd., Hyderabad	Non-exclusive
Energy Conversion			
	CFRI		
52	Pelletising followed by devolatization of washery middling rejects, slurries and/or high ash coking coals	S.K. Industries Works, Calcutta	Non-exclusive
	IIP		
53	Low air pressure (LAP) Burner	ENCON Thermal Engineers, Faridabad	Exclusive
54	Improved LPG Stove	Sunflame Industries	Non-exclusive
	CMERI		
55	LP Gas Stove	Selection Appliances Pvt. Ltd, Ludhiana	Non-exclusive
	Others		
56	Bullock cart technology	Blam Organ Industries, Panipat	Non-exclusive

APPENDIX II

PROCESSES RELEASED TO INDUSTRY
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party
Products of Food Industry, Including Beverages		
	CFTRI	
1	Compounded asafoetida	(1) Tated and Singhi, Madras (2) Shri Chandrakant T. Vora, Viramgam
2	Thermal processed fish products	Southern Sea Food Pvt Ltd., Madras
3	Dehulling of musk melon seeds	(1) Shri Reval Singh, Jullundur (2) Shri Rajeshwar Nath, Panipat (3) Dinesh Trading Corporation, Ajmer
4	Cocoa biscuits	(1) Visco Food Products, Ernakulam (2) United Bakeries Ltd, Angamali
5	Cocoa cream biscuits	(1) Visco Food Products, Ernakulam (2) Azad Industries, Mangalore
6	Rennet for cheese making	Beauty without Cruelty, Pune
7	Chakali mix	Rama Krishna Dairy, Bangalore
8	Ready mix for quick crud	(1) Natwarlal G. Patel, Atul (2) Chitala Bandhu Mithaiwala, Pune (3) Punjab Udyog Ltd., Chandigarh
	RRL, Jammu	
9	Bottle apple juice and canned mushroom	Effico Fruit & Products, Srinagar
10	Ready to serve mango pine apple and lime beverage	Summit Fruit Products, Jammu
11	Utilisation of apple, pomace	J&K Industrial Development Corporation, Srinagar
12	Mango drink furit squashes & nectars	Sandip Fruit Products, Jammu
	RRL Trivandrum	
13	White pepper powder from black pepper	Universal Oleoresins, Cochin
14	Bottling of coconut water	Jaya Beverages, Nagarcoil
Chemicals		
	CFTRI	
15	Chitosan and chitin	Coffee Lands Ltd., Saklaspur
	CS&MCRI	
16	Sodium chloride AR and IP	Indian Allied Chemicals, Berhampur
17	Elutriation classification of calcium carbonate	Industrial Chemicals, Bombay
18	Potassium silicate	Saraswati Industries, Bhopal
	NCL	
19	Adhesives from renewable resources	Carborundum Universal, Madras
20	Phenylglycide	Sudarshan Chemical Industries, Pune

APPENDIX II

PROCESSES RELEASED TO INDUSTRY—*Contd.*
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party
	NML	
21	Zinc oxide from zinc waste	Subhodaya Chemicals, Kovur, Nellore
	RRL, Jammu	
22	Precipitated calcium carbonate	Trikula Chemicals
23	Herbal cream	Lupin Labs Ltd, Bombay
24	Concentrated herbal extract	Saibaba Industries (P) Ltd., Bombay
	RRL-Bhubaneswar	
25	Strawberry aldehyde	Rusikulaya Aerochem, Berhampur
	RRL-Jorhat	
26	SWAT-106	(1) Hindustan Insecticides Ltd., New Delhi (2) HICO Products Ltd, Bombay
	RRL-Hyderabad	
27	Epoxy resins based on card bisphenol	Synth-Chem Industries, Hyderabad
28	Phosgene	Hindustan Organic Chemicals Ltd., Rasayani
29	Dehydrated castor oil	Dujodwala Industries, Faridabad
Metallurgy		
	NAL	
30	Standardisation of analysis of ferrosilicon	Nava Bharat Ferro Alloys Ltd., Hyderabad
	NML	
31	Creep resistant steels	BHEL, Hyderabad
32	High strength aluminium alloy NML-PM 215	Electrical Manufacturing Co. Ltd., Calcutta
33	NML-PM-6 welding filler wires/rods	Karnataka Aluminium Ltd., Mysore
34	Electrolytic copper powder	Tapadia & Co., Jamshedpur
Materials		
	CGCRI	
35	Glass colours/glass enamels	SN. Glass Decorators, Firozabad
36	Ceramic beaded PTFE neutral section assembly	RDSO, Lucknow
	NAL	
37	FRP cones for fosters scanner antenna system	RDSO, Lucknow
Machinery		
	CFTRI	
38	Rice bran stabiliser	Dayanand Extraction Industries Pvt. Ltd., Tumkur

(Contd.)

APPENDIX II

PROCESSES RELEASED TO INDUSTRY—*Contd.*
(FOR THE FIRST TIME IN 1983-84)

Sl. No.	Process	Party
	NPL	
39	Plate plate collector	Ranna & Co P. Ltd., New Delhi
Drugs & Pharmaceuticals		
	CDRI	
40	D-Propoxyphene hydrochloride	Wock hardt Synchem Pvt. Ltd., Bombay
41	Paracetamol	(1) Linchem Laboratories, Calcutta (2) Ramani Chemasea, Madras
	RRL-Jammu	
42	Testosterone	CIPLA, Bombay
43	Terpineol B.P. grade	Prabhat Terpines & Synthetics Pvt. Ltd., Jammu
Pesticides		
44	Agrotechnology for pyrethrum	Dr. Patani Scientific & Industrial Reseach, Bombay
Electronics		
	CEERI	
45	Over/under voltage protection device	A System, Pilani
46	S-Band magnetron	DRDL, Hyderabad
47	32 Lines electronic telephone exchange	Power Electronics & Controls, Baroda
48	6.00 GHZ TWT	ISRO, Bangalore
	CSIO	
49	Ultrasonic hardness tester	(1) Technological Consultant Centre, New Delhi (2) Blue Steel Engineers Pvt. Ltd, Bombay
	CEERI	
50	DC Thyristorised motor control devices	P.S. Industrial, Madras
51	CTV technology	CEL, Sahibabad
	NAL	
52	Pattern tin plating of printed circuit board	Raman Research Institute, Bangalore
Instruments		
	CSIO	
53	Pipe & cable locator	Rallies Engineers, Delhi
	NGRI	
54	Single channel refraction seismic timer	Integrated Geo-Instruments & Services Pvt. Ltd., Hyderabad

APPENDIX II

PROCESSES RELEASED TO INDUSTRY—*Contd.*
(FOR THE FIRST TIME IN 1983-84)

Sl No.	Process	Party
	CSIO	
55	Electrospot analyser testing kit (meta-spot)	(1) Shri S.P. Sharma, Panchkula (2) Metal Spot Engineers, New Delhi
	CECRI	
56	Ion sensitive electrode	Progressive Piston Company, Hyderabad
Others		
	RRL, Trivandrum	
57	Extending the life of coconut leaf thatch	Kerala Housing Board, Trivandrum
58	Cultivation of *Gelidiella accrosa* (Seaweeds)	Cellulose Products of India Ltd., Ahmedabad

APPENDIX III

CSIR PATENTS FILED, ACCEPTED AND SEALED IN INDIA AND ABROAD DURING THE PERIOD 1.4.1983 TO 31.3.1984

Name of the Laboratory	INDIA			ABROAD		
	Filed	Accepted	Sealed	Filed	Accepted	Sealed
CBRI, Roorkee	—	1	3	—	—	—
CDRI, Lucknow	13	—	9	1	—	—
CECRI, Karaikudi	1	4	10	1	—	—
CEERI, Pilani	3	—	—	—	—	—
CFTRI, Mysore	2	—	—	—	—	—
CFRI, Dhanbad	2	—	—	—	—	—
CGCRI, Calcutta	1	1	1	—	—	—
CLRI, Madras	—	—	2	—	—	—
CIMAP, Lucknow	—	—	1	—	—	—
CMERI, Durgapur	4	1	—	—	—	—
CMRS, Dhanbad	1	2	2	—	—	—
CSIR, Scheme	1	1	—	—	—	—
CSMCRI, Bhavnagar	3	1	—	—	—	—
IICB, Calcutta	5	1	2	—	—	—
IIP, Dehradun	3	2	1	—	—	—
MERADO, Ludhiana	—	1	—	—	—	—
NAL, Bangalore	1	—	2	—	—	—
NCL, Pune	10	2	4	—	—	—
NEERI, Nagpur	1	—	1	—	—	—
NGRI, Hyderabad	2	1	1	—	—	—
NML, Jamshedpur	4	2	—	—	—	—
NPL, New Delhi	—	—	3	—	—	—
RRL, Bhubaneswar	7	—	4	—	—	—
RRL, Hyderabad	2	4	6	—	1	—
RRL, Jorhat	2	1	2	—	—	—
SERC, Roorkee	—	1	—	—	—	—
TOTAL	68	26	54	2	1	—