

annual report

1988-89

Council of Scientific & Industrial Research
New Delhi

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Industrial Research
New Delhi

Compiled and edited by
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with the assistance of
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CSIR
New Delhi

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COUNCIL OF SCIENTIFIC &
INDUSTRIAL RESEARCH

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COUNCIL'S ESTABLISHMENTS

PHYSICAL AND EARTH SCIENCES GROUP

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 GROUP

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, Dehradun	(IIP)
Central Leather Research Institute, Madras	(CLRI)
Central Fuel Research Institute, Jealgora	(CFRI)

BIOLOGICAL SCIENCES GROUP

Central Foo.d Technological Research Institute, Mysore	(CFTRI)
Central Drug Research Institute, Lucknow	(CDRI)
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 of Microbial Technology, Chandigarh	(IMTECH)
CSIR Complex, Palampur, HP	(CSIR Comp. Palampur)
CSIR Centre for Biochemicals	(CFB)

ENGINEERING SCIENCES GROUP

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, Dhan bad	(CM RS)
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, Ghaziabad	(SERC-G)
Regional Research Laboratory, Bhubaneswar	(RRL-Bhu)
Regional Research Laboratory, Trivandrum	(RRL-Triv)
Regional Research Laboratory, Bhopal	(RRL-Bhopal)

INFORMATION SCIENCE GROUP

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

Tocklai Experimental Station of TRA, Jorhat	(TESTRA)
Electrical Research & Development Association, Vadodara	(ERDA)

now known as the Indian Institute of Chemical Technology (UCT)

PERSPECTIVES

CSIR, unlike organizations like ICAR, ICMR, ISRO, etc. which undertake R&D programmes for specific sectors, is a multidimensional organization and has a definite and major role to play in the development process of the country. The charter of CSIR envisages:-

> Research and development directed towards continuous improvement of indigenous technology and adaptation and development of imported technology: R&D projects of national priority; R&D for new technologies, appropriate and alternate technologies, basic research, maintenance of national standards, technical services like information, extension, etc. etc.

The resources made available to CSIR have not been totally commensurate with these objectives. Further the level of government resources has also declined in the context of total resources for R&D in the country. In the V Plan the allocation for CSIR was about 12.6% of the total funds for S&T and this has come down to around 7% in the VUI Plan period (see table below).

Table : Central S&T allocation®

Period (Plan)	CSIR Share %
V	12.6
VI	13.9
vn	11.6
vni	7*

* Estimated.
@ Derived from DST statistics.

Notwithstanding this decline of its share, CSIR has attempted to offer the nation output of considerable value. For instance industrial production based on CSIR knowhow is on the increase and has exceeded Rs.800 crore by end of 1988 and the cumulative output stood at Rs.7600 crore (see diagram on p. VII). Savings accruing through CSIR efforts have been estimated (diagram on p. VUI) to be around Rs.850 crore in 1988). CSIR has also helped build a strong base for S&T in specific areas. In certain areas levels of excellence have been attained. For example NPL has achieved world-wide recognition in superconductivity, material sciences and radio and atmospheric sciences; CCMB has already made a mark in molecular biology; in the area of catalysis, NCL has been recognized internationally; NAL has made a mark in composite materials and parallel computing; and IICT is recognized as an important centre for the development of indigenous technologies for drugs and pesticides. There has also been a steady growth in terms of external cashflow. By 1988-89 it has reached about Rs.55 crore. A fair portion of the earnings came from industrial enterprises - public and private (see illustrations on pp. IX, X, XI).

The technologies developed by CSIR laboratories have also attracted world-wide attention and now we are at a stage of exporting some of the technologies not only to developing countries but also to developed countries. Technology for the production of Gugulipid, a hypolipaedemic drug, has been sold in France. Negotiations have reached an advanced stage for export of technology for butenediol to Brazil, selected drugs and pesticides to Vietnam and Bangladesh. In the area of technologies for the fulfilment of societal and other missions, CSIR has contrihited a great deal to their success. The societal missions in which CSIR laboratories have been totally involved are provision of drinking water and technology mission on oilseeds. Ground water exploration through geoelectrical soundings has been completed in more than 850 potential sites. Wat a* quality assessment for more than 3500 villages is over. A number of demonstration plants for deflouridation, iron removal, conversion of saline water into potable water and rain wato* harvesting have been installed in several sites of the country.

In the next plan period CSIR proposes to devote at least 50% of its manpower and financial resources to goal oriented missions and mission mode programmes. These are classified as

Societal/Technology Missions
CSIR in National Scientific & Technological Programmes
CSIR's own Mission Programmes

Some examples in these groups are

Societal/Technology Missions

Drinking Water
Oilseeds
Immunization
Natural Hazard mitigation
Rural Development

CSIR in National S&T Programmes

SROSS Aeronomy Satellite Programme (to be launched in 1991 carrying NPL payload)
Superconductivity (SQUID to be got ready by March 1990)
International Geosphere Biosphere Programme (IGBP)
LCA
Navodaya Vidyalaya-cum-Special Buildings

CSIR Mission Programmes

New Materials
Microelectronics
Agrochemicals
Catalyst Science and Engineering
Corrosion
Petroleum Refining and Petrochemicals
Polymer Science and Technology
Industrial Toxicology
Coal: Beneficiation, Transportation, Utilisation & Gasification

Major Facilities

VLBI
Mathematical Modelling (C-MMACS)
Special Purpose Aircraft
New Low/High Speed Wind Tunnel
Component Integrity Evaluation Centre
RV Gaveshani II
National Instrumentation for Biology
Mineral Physics

Human Resources Development

There is increasing demand from different sectors of the government and industry for S&T. support from CSIR: in the Action Plan relating to rural development, beginning January 1990 in generating competitive technologies, in assisting industries for absorption of indigenous and foreign technologies and providing S&T base for major areas of national development. This would necessitate a sizeable growth in terms of human resources also, particularly since, as in many other countries, many of our distinguished scientists and technologists are retiring or will retire soon. R&D manpower development at national level is one of the important activities of CSIR. Presently the national stock is of the order of one lakh in the R&D sector. We believe that it should at least be doubled by the end of the VIII Plan, if we are to seriously implement the many national programmes being undertaken. To achieve this objective a national effort is called for. CSIR on its own has developed a strategy.

Presently about 1000 fellowships are awarded every year based on a joint CSIR-UGC examination. A total of about 4000 CSIR supported fellows are working in different institutions as of now. It is proposed to double this number and augment the number of senior fellowships, research associateships etc. to help attain the objective of doubling the present level of R&D manpower by 1995.

Research Schemes in forward looking areas formulated by scientists/technologists from any stream are entertained and funded by CSIR after peer review. Presently over 700 such R&D schemes are in operation. It is proposed to increase this number and the inputs on need based realistic basis so that the output is optimised within stipulated time frames.

Other activities/schemes like the Scientist's Pool, TOKTEN, are to be continued more intensively to obtain best results from foreign based Indian brain banks. A new scheme to attract contribution from NRIs is being initiated soon. Here CSIR has been asked to form the nodal centre INRIST.

It is envisaged that scientific manpower will gradually increase in proportion and is expected to ultimately attain a ratio of 1:1 (scientific : supporting staff) by the year 2000.

About 200 scientists a year are also deputed abroad under various bilateral/multilateral agreements for interaction/training in advanced/high priority areas of research. This strategy is being strengthened now and we are already sponsoring a few young/promising scientists (as RAMAN FELLOWS) in emerging areas every year to advanced centres of work with eminent scientists with CSIR funds to cover all costs.

Besides the on going award systems like the S S Bhatnagar Award, new schemes like the Young Scientist Award have recently been introduced for encouraging brilliant young researchers.

Beginning from 1990 it is proposed to institute Technology Awards similar to the Bhatnagar Awards. The focus for all these activities is the enhancement of the quality of manpower and maintenance of excellence in specialized fields. The quality of manpower of CSIR gets recognized

year after year. There are a number of fellows of academies and scientists who have achieved international recognition in the year under review.

International Collaborative Efforts

CSIR now has about 20 overseas bilateral agreements with governmental and non-governmental departments/academies. These programmes have been utilized for augmenting national capabilities and providing a useful forum for undertaking collaborative work with academies/scientists having interest in our R&D efforts. It is proposed to strengthen the same and undertake major new activities in tune with our need and priorities.

As a new development, it is proposed to interact with developing countries and provide R&D assistance to them in several areas of excellence which have developed as a result of our efforts in the country. Some of them are: drinking water including desalination, pesticides, catalysis, aromatic packages, failure analysis, aeronautics, drugs, medicinal plants etc.

As a means of furthering collaborative efforts CSIR proposes to award upto 100 fellowships a year to scientists from developing countries, particularly those in the neighbourhood, for visiting and working in CSIR laboratories for a period of a year or two in each case. They will be required to register for higher degrees in their respective countries and their work in India could be oriented to supplement their studies in countries of origin. This will also help in direct transfer of technology between our country and their countries, both in terms of a software and hardware.

Approach to VIII Plan.

The approach to the VIII Plan consists of the following guidelines :-

- Consolidation and modernisation
- 'Focused Targets

— No New Laboratories but specialised Multi-Lab Centres.
— Larger support to Universities (from 6% to 10%)

- Manpower Development Strategies (1 :l=scientific staff: supporting staff)

— Cashflow increasing at 25% per year

- Development of S&T manpower in new areas of Oceanography, Ceramics, Superconductivity etc.
- New Technological initiatives at Hq.: Data Base, Safety Monitoring, Technology Gate-Keeping, Archiving and Preservation Technology.

— National Conference Centres.

Delhi	(NPL, Campus)
Goa	(NIO, Campus)
Hyderabad	(RRL-Hyd. Campus)
Calcutta	(Jadavpur Area)
Madras	(CLRI, Campus)

Trivandrum:
and Interface of NRIs for S&T (INRIST)

By the end of the Seventh Plan (1989-90), total investment on R&D will be around 1.1 per cent of GNP. There is need now to take steps to raise the level so that it becomes at least 2 per cent or GNP by the end of the eighth plan (1994-95). Whenever there is a resource constraint, cuts in budgets are imposed uniformly on all sectors, including on S&T. This is unfortunate. It has to be recognized that investment on R&D is essentially investment on national development.

July 1990
New Delhi

A P Mitra
Director General

BASIC DATA

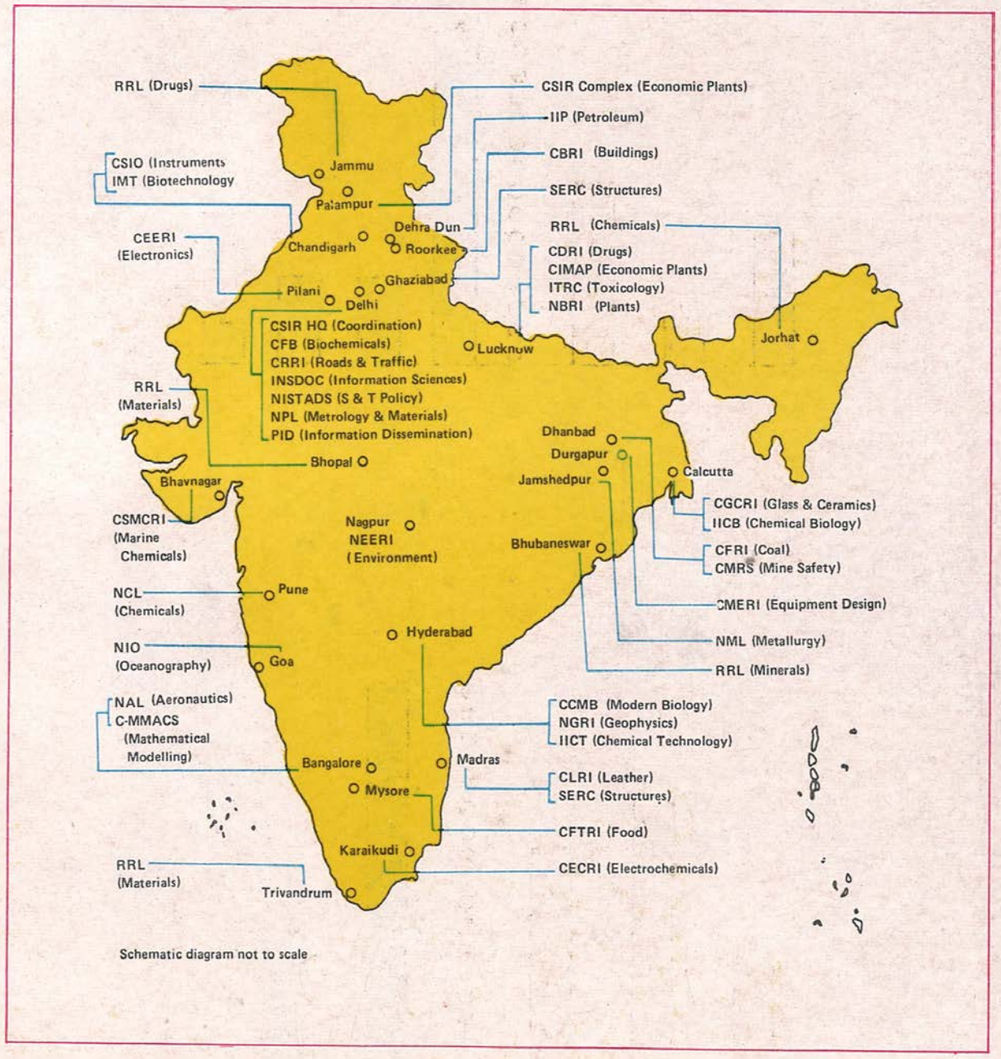
National Laboratories/Institutes	39
Industrial Research Associations	2
Extension Centres/Field Stations etc.	101
Total Staff (incl: vacancies in process of being filled)	28054
Scientists	6992
Supporting scientific & technical staff	13977*
Administrative staff (other than group D)	5039
Administrative staff (group D)	2046**
Research committees	16
Research schemes in progress	840
Emeritus scientists	60
Pool scientists (as on 31.3.1989)	635
Research Fellows/Associates	3674
Processes that have gone into production	15
Processes released to industry	57
Patents filed	130

BUDGET FOR 1988-89 (Rs. in CrOre)

*	Sanctioned estimates 1988-89	Revised estimates 1988-89	Actuals 1988-89
Plan	76.50	76.74	76.74
Non Plan	120.00	120.00	120.00
Total	196.50	196.74	196.74

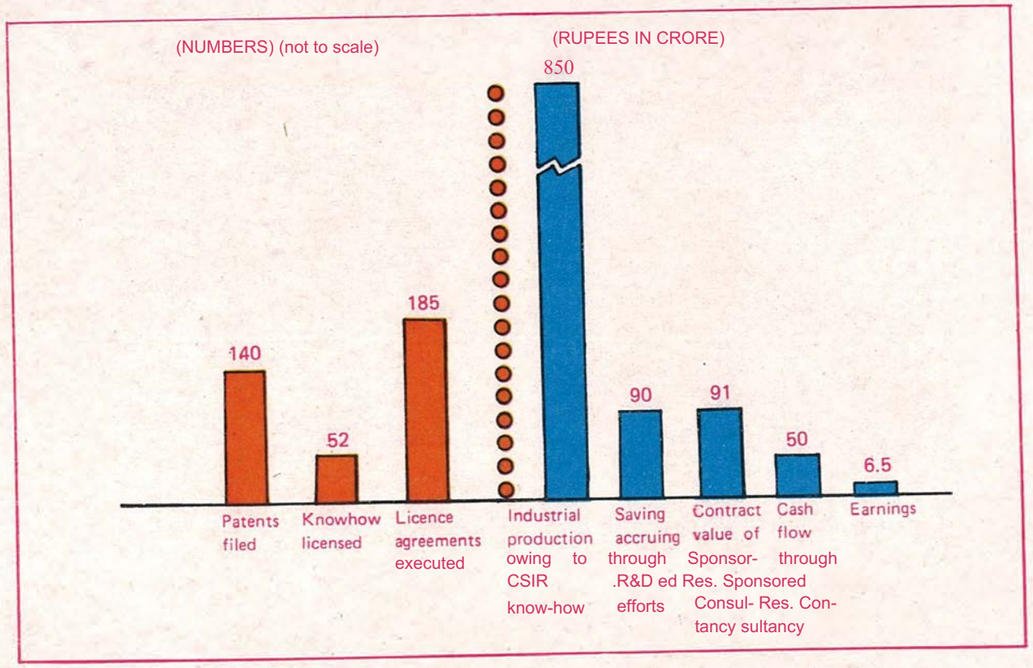
* Incl: also Gr 1 Tech, posts equivalent to Group D (Admn.)
** Excludes Gr I Tech.

CSIR NETWORK

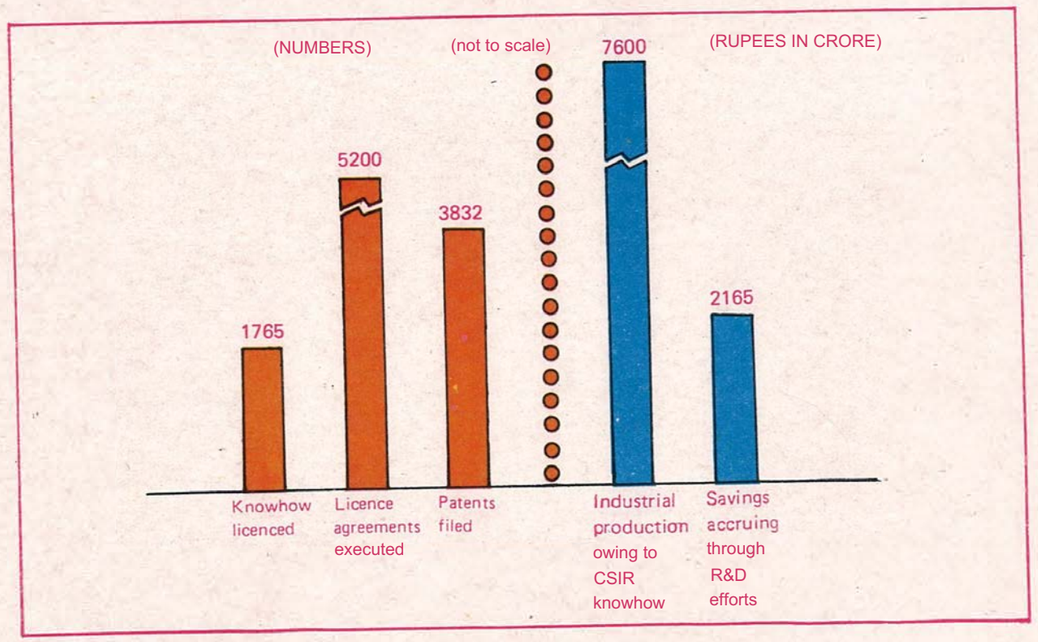


Schematic diagram not to scale

RESEARCH OUTPUT IN 1988



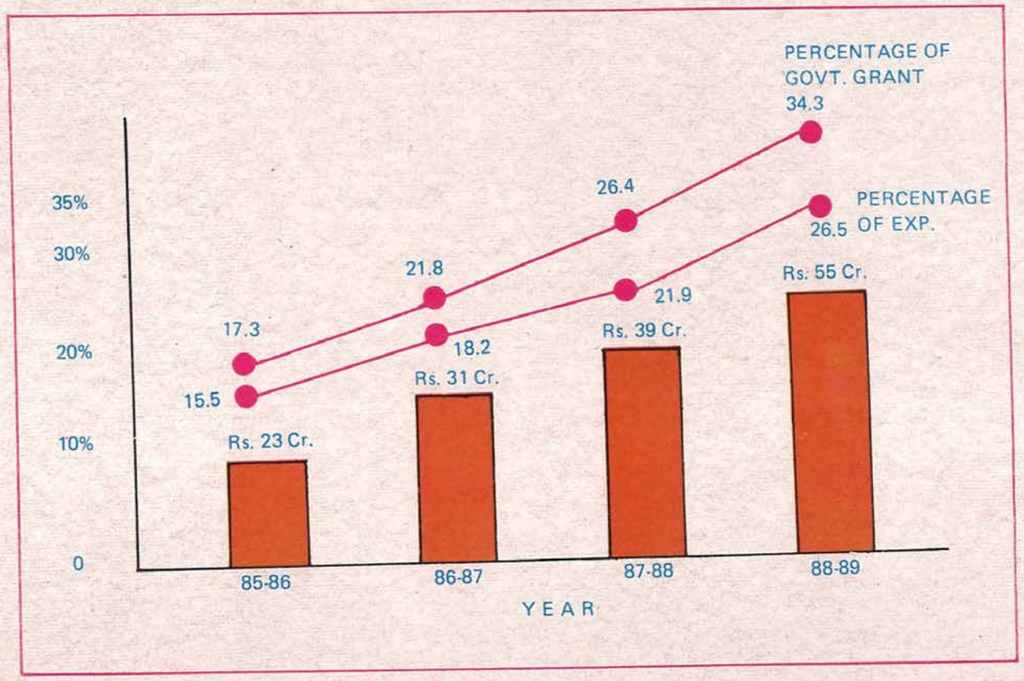
RESEARCH OUTPUT COMULAITVE



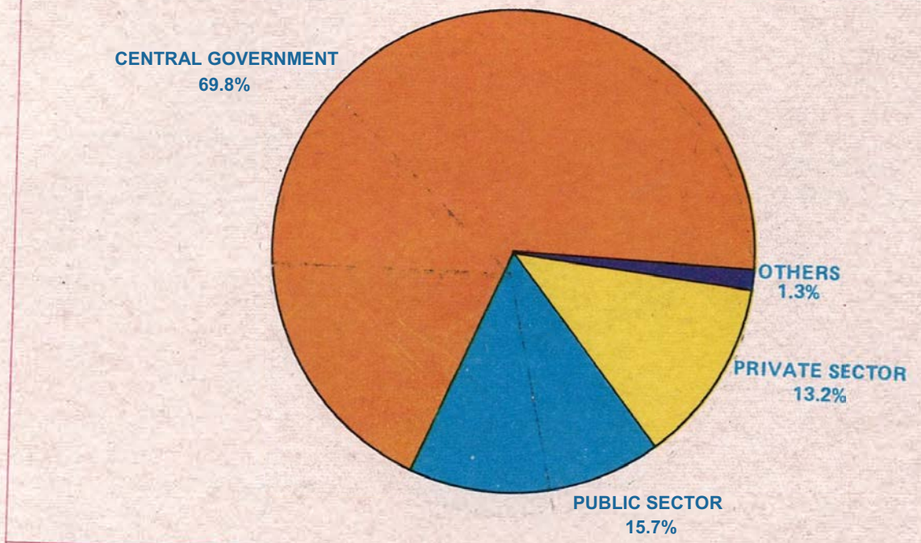
RESEARCH OUTPUT INDICATORS

	1988	Cumulative
Knowhow licensed (No.)	52 (New)	1765
Licence agreements executed (No.)	185	5200
Industrial production based on CSIR knowhow (Rs crore)	850	7600
Savings accruing through CSIR R&D efforts (Rs crore)	90	2165
Patents filed (No.)	140	3832
Contract value (Rs. crore)		
(a) Sponsored Research	84	
(b) Consultancy	7	
Cash flow (Rs. crore) through		
(a) Sponsored Research	45	
(b) Consultancy	5	

EXTERNAL CASH-FLOW

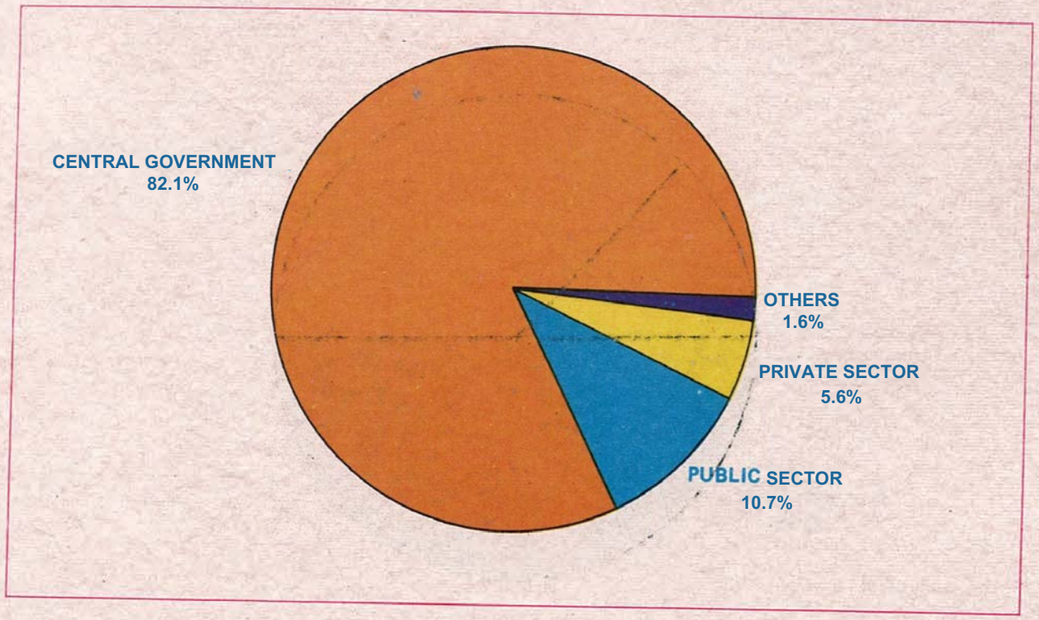


EXTERNAL CASH FLOW (Break-up) TOTAL Rs. 55.4crore

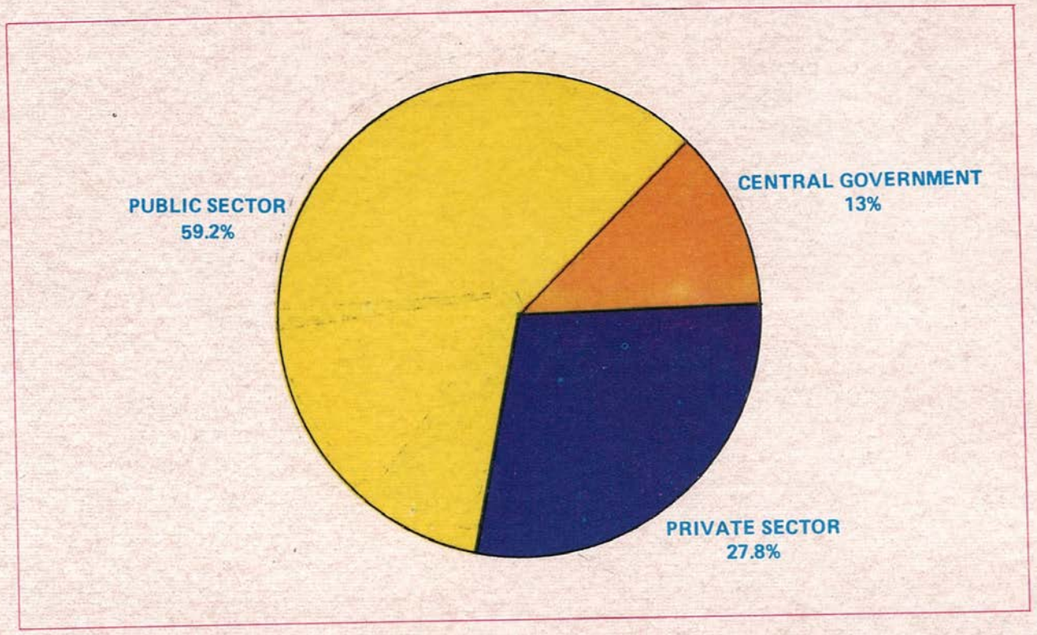


CONTRACT RESEARCH (Break-up of Cash Flow)

TOTAL Rs. 44.8 Crore

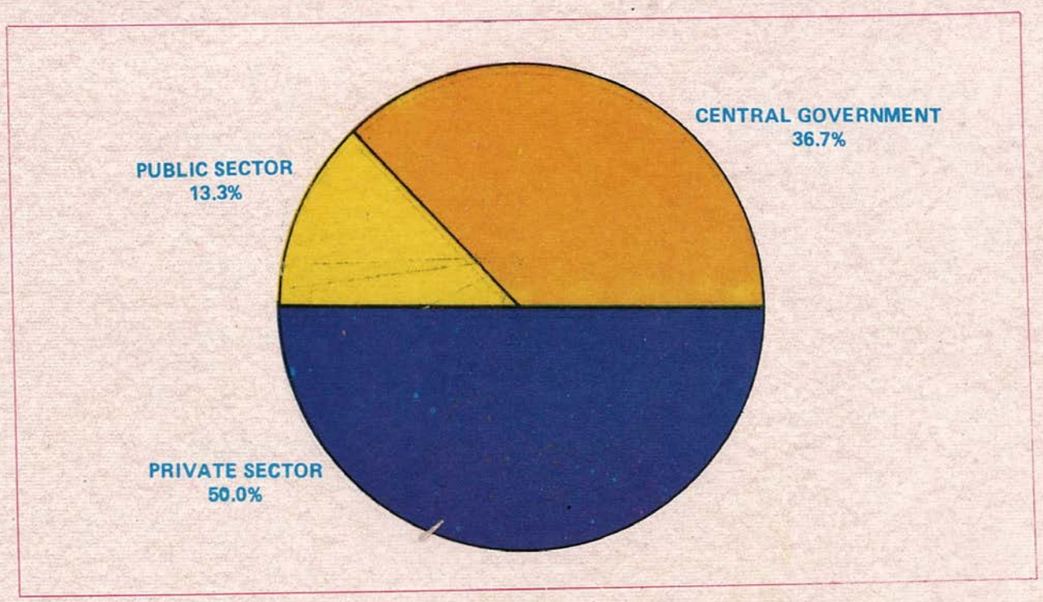


CONSULTANCY (Break-up of Cash Flow) TOTAL »•" Crore

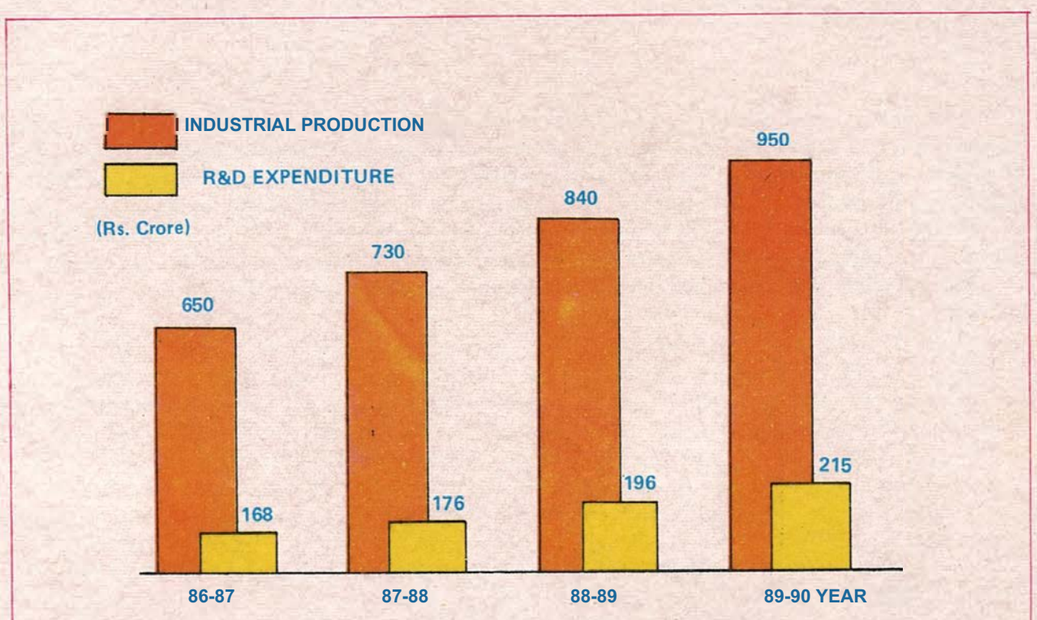


TECHNICAL SERVICES (Break-up of Cash Flow)

TOTAL Rs. 3.0 Crore



ESTIMATED ANNUAL INDUSTRIAL PRODUCTION Vs R&D EXPENDITURE (Based on CSIR Knowhow)



RESEARCH UTILIZATION AT A GLANCE

During the year 15 new processes went into production (Appendix I) and 57 processes were licensed to industry (Appendix II). The cumulative total of processes released to industry as on March 1989 was 1765; of these 773 processes were reported to be in commercial production.

During the year around 750 sponsored projects of contract value of over Rs 8400 lakh, and about 550 consultancy projects of contract value around Rs 720 lakh were on hand.

Money received through licensing of intellectual property for the last three years was as follows:

Year	(Rs. Lakh)
1986-87	50.92
1987-88	59.53
1988-89	76.60

HIGHLIGHTS

CSIR undertook a programme on a Hololological Approach to Water Mission in Barmer, East Sikkim and Nagpur districts. The scientific inputs were provided by NEERI, NGRI, CSMCRI, ITRC, SERC and NBRI as also the Central and State government agencies. The assignment included hydrogeological investigations through remote sensing and geophysical surveys; treatability studies as basis for design of water purification systems; topography surveys as basis for engineering designs; development of software for dissemination of technology and community awareness programmes. Relevant data on socio economic and cultural indicators for assessment of pre-project conditions of Environmental Impact Analysis have also been collected.

The inputs provided by CSIR laboratories towards fulfilment of the Technology Mission on Oilseeds included an economical process for stabilization of rice bran, design of a modern oil expeller, technology for decortication of sun-flower seeds, design for storage of oilseeds and technology for processing of palm oil. Trials with improved expeller have proved that by using this expeller, efficiency and productivity of extraction of oil would increase.

The laboratories of the Physical Sciences Group have been concerned with programmes relating to Standards, Radio and Space Physics, Electronic Devices and Systems, Oceanography and Geophysics. A laser heterodyne system has been set up at NPL; CEERI has developed micro-processor based process control systems and a component for electric power control systems. It has also developed hybrid micro circuits for INSAT-II. A 4 Me V linear accelerator machine has been developed by CSIO. Magnetic and electric resistivity surveys were made by NGRI for locating targets of archaeological interest in Andhra Pradesh. On behalf of ONGC, NIO collected precision gravity data in the Bombay High and adjoining areas for locating oil bearing strata.

New developments have been noticed in the area of chemicals, chemical engineering, and metallurgy. A new route has been developed by NCL for the production of a carbamate pesticide. A new anode for cathodic protection has been developed by CECRI, without the use of mercury. The process flow-sheet for the recovery of copper, nickel and cobalt from polymetallic nodules has been prepared by NML.

An improved strain of lemongrass and development of high-yielding variety of mentha citrata are two of the notable achievements in the area of agro-technology. CLRI has discovered a microbial enzyme for unhairing of hides and skins. Large scale trials of unhairing in commercial tanneries using this enzymes have been planned. NCL has succeeded in isolating from the desert sands of Rajasthan a unique strain secreting an enzyme capable of selectively degrading hemi-cellulose. This discovery is hailed as a break-through for the paper industry. The enzyme is undergoing joint evaluation by NCL, the Iowa State University and the International Paper Company, USA.

The important programmes in the area of coal relate to techniques of extraction under difficult ground conditions, utilization of mine wastes and an integrated approach to improvement of mine environment (also known as MMAHA - Mines, Metals and Habitat). NEERI carried out a number of environment impact assessment studies for ONGC, petrochemical industries and paper mills.

Materials - building materials and composite materials - continue to be an area of thrust in CSIR laboratories. NPL has developed flexible graphite foil using totally indigenous raw materials. This material offers outstanding resistance to corrosion at high temperature and can retain compressibility at all temperatures. It has been found to be an excellent substitute for asbestos. A carbon

fibre rudder for the Dornier aircraft jointly developed by NAL and DFVLR has successfully pajed ground tests CGCRI in collaboration with CMRS and CSIO, has successfully installed an optical fibre telephone system in a coal mine near Dhanbad. An energy efficient gypsum calcinator has been developed by CBRI. Based on this knowhow, four calcinators are in commercial use.

SERC(G) undertook the instrumentation of Narora Atomic Power Project containment Vessel and assessed its structural behaviour during pressure tests. Computer software was developed: by RRL, Jorhat and CLRI for simulating of flow type and pressure drop in a network of oil pipelines; by SERC (M) for alignment of propulsion shafts in ships and submarines and by NAL for managing and analyzing wind tunnel data on aircraft configurations. The CSIR Centre for Mathematical Modelling and Computer Simulation (C-MMACS) was inaugurated in March 1988.

In basic research, significant developments have been reported in superconductivity (NPL, CEERI), cellular and molecular biology (CCMB), catalysis (NCL and IIP) and toxicity studies (ITRC). Among the national facilities created are CNC Milling Machine facility by CSIO and a new transonic wind tunnel with test section size of 0.6m x 0.6m x 0.6m by NAL. CSIR has entered into memoranda of understanding with ONGC, Central Board for Water Pollution, DRDO and the departments of biotechnology and non-conventional energy sources of the Government of India for various programmes.

DRINKING WATER MISSION

NGRI carried out geophysical exploration and hydrogeological studies in a number of difficult areas covering the districts of U dampur, Barmar, Mirzapur, West Khasi, Nagpur, Koraput, Gulbarga, Mahbubnagar, Raichur, Dharwar and Ramanathpuram, for locating suitable drilling sites for groundwater. Out of 342 sites recommended for drilling 178 wells have been drilled by concerned State Govt, agencies.

A total of 157 problem villages of Darrang District of Assam and 119 villages of South District of Manipur was covered and the water quality assessment reports of these villages made available (by RRL-Jorhat) to the Public Health Engineering Departments of respective States. Based on these reports 15 water treatment plants in Manipur and 12 water treatment plants in Darrang District have been installed.

ITRC covered a total of 1052 villages covering an approximate population of 4,99,810 to carry out water quality assessment in 14 states of North-Eastern region of the country. Samples of water of 7 districts, namely, Leh, North Tripura, East and South districts of Sikkim, Barmer, Koraput, Nagpur, and Trans Yamuna Area of Delhi were analysed for the National Water Mission. The baseline data on bacteriological, metal and pesticide contamination of rural drinking water were collected.

A Seawater Desalination Plant of 5M^/day capacity has been installed at Kavaratti in Lakshadweep Islands. The electrodialysis plant is based on an improved design which prevents scale formation and uses *a* non-chloride electrolyte as anode to enhance the membrane life. The plant is performing at about 18 Kwh/M^ with a water recovery of 50% from seawater at a residual concentration of 700-800 PPM. A mobile desalination plant and a stationary plant based on CSMCRI technology were handed over to the Government of Thailand by the Vice-President of CSIR at New Delhi. These plants will cater to the drinking water needs of arid regions of Thailand. The Government of Thailand has ordered 35 more reverse osmosis plants thereby indicating their confidence in the technology developed nation coefficien

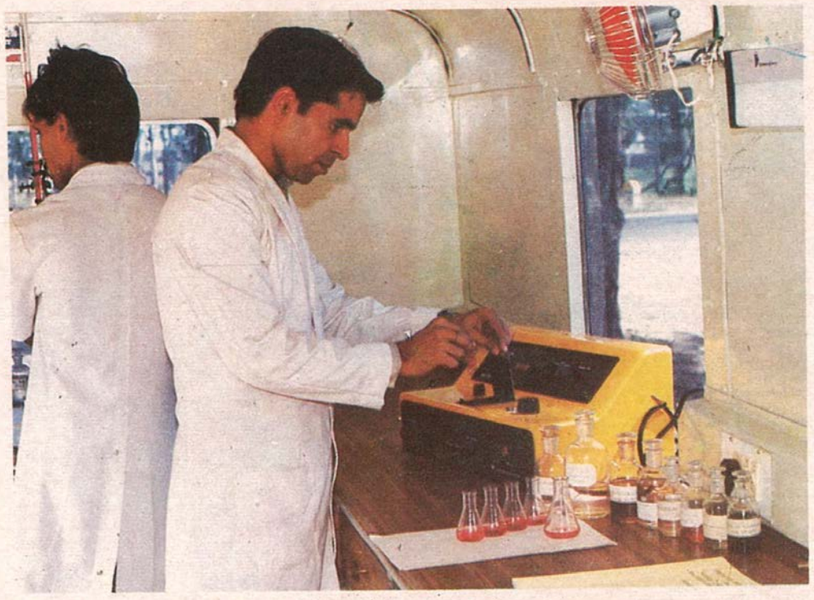
their confidence in the technology developed by CSMCRI.

A novel water economy tap has been designed by CMERI. A prototype has performed successfully. The tap will be useful in avoidance of wastage of drinking water in public installations.

Twentyfive numbers of prototype of shallow-well hand pump were handed over by CMERI to the Madras Metropolitan Water Supply and Sewerage Board for field testing. Modification, of a few components is in progress.

Development of a Mobile Water Analysis Laboratory

ITRC has developed a mobile water analysis laboratory for use in the rural areas. This air-conditioned mobile laboratory has been fully equipped to carry out on-the-spot analysis of water in relation to safety of drinking water sources, in rural and urban areas. The tests performed will provide information on the treatments required to make the contaminated water suitable for drinking purposes. There is adequate space to accommodate equipment, laboratory wares and chemicals necessary to undertake water quality analysis for a period of one month.



Inner view of the Mobile Water Analysis Laboratory

POSITION AT THE END OF 1988

Exploration	
Ground water exploration through geoelectrical soundings	2000 studies 669 villages 862 potential sites 2900 kl/hr additional water
Water quality	
Assessment	3516 villages
Technology of water treatment	
Water evaporation retardants	Alkoxy ethanols
R.O. membranes	Cellulose Acetate based (90% desalination)
Guinea worm vector control	Controlled release dispensor Fernasol and cedrus oil

Demonstration Plants Installed		
Defluoridation	8	AP, Gujarat, Haryana
Iron Removal	5	Tripura, U.P.
R.O. Mobile'Plants	8	Karnataka, A.P., Rajasthan, M.P., T.N., Gujarat, U.P.-
R.O. Stationary	5	Rajasthan
Rain Water harvesting and storage structures	30	Manipur, Meghalaya, M.P., U.P.

Plants Under Installation (Targeted)	
R.O. Desalination	130
Defluoridation	130
Iron removal	5000



Defluoridation Plant at Tartur, A J>.



Defluoridation Plant at Fazilpur, Haryana

Training Programmes

Course Title	Organised by	No. of courses	Participants
Defluoridation	NEERI	8	532
Desalination	CSMCRI	3	32
Geophysical Exploration	NGRI	5	145
Iron removal	NEERI	6	158
Water quality Analysis	NEERI, ITRC, RRL-J	10	269
Rain water Harvesting	SERC-G	9	320

ANALYTICAL KITS/INSTRUMENTS

	Instruments	Parameters Covered	Measurement Mode qualitative/Quantitative	Power Requirements	Size in cm	Weight
1.	ITRC Titration kit for residual chlorine	Residual chlorine Fe & F;	Quantitative	Nil	50x35x28	16 kg
	Kit with colorimeter for Fe & F		Quantitative	Mains power 230V, 50Hz		
	ITRC Bacteriological kit	Bacteriological	Presumptive 48 hrs; MPN test or 24 hrs MF test	Mains Power 230V, 50Hz or Generato		
2.	NEERI rapid aqua tester	Residual chlorine Fe & F	Quantitative	Nil	9.7x9.7x3.1	300 kg
	Rapid bacteriological tester	Bacteriological	7 & 12 hrs confirmatory Faecal Coliform	Mains power 230V, 50Hz Battery/solar panel	49x34x30	10 kg
3.	Electronically controlled incubator (CEERI)	Bacteriological	Presumptive	12V battery	35x30x30	7 kg

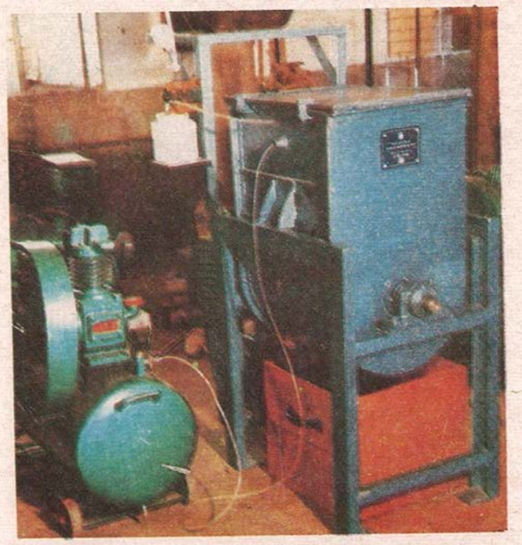
TECHNOLOGY MISSION ON OILSEEDS

Rice Bran Oil

An economical process for stabilization of fresh rice bran (to deactivate fat splitting enzyme Lipase) with acid treatment has been developed by CFTR1. Acid stabilised, parboiled and fresh rice bran has been processed recently at the FCI Solvent Extraction Plant at Sembanarkoil (Tamil Nadu). Trials have shown no adverse effects on solvent plants; rather the effect would improve the life of the solvent plants. If all available rice bran is treated as soon as it is extracted from rice mills it could yield 3 lakh tonnes of edible grade rice bran oil against the existing production of 1.2 lakh tonnes.

Design of modem oil expeller

Improved expellers are being designed and developed and the prototypes made are being optimised at MERADO, Ludhiana. These will reduce residual oil content in the cakes from the present level of 8-9% to 4-5%, increasing thereby edible oil supply by 4% if the existing 36,000 expellers are replaced by the improved ones. The improved expellers will also reduce wear and tear and shut-down time and increase the efficiency and the productivity. Energy consumption will also be reduced by 10-15%. Industrial trials are expected to be taken up.



Rice bran stabilizer

Sunflower decorticator

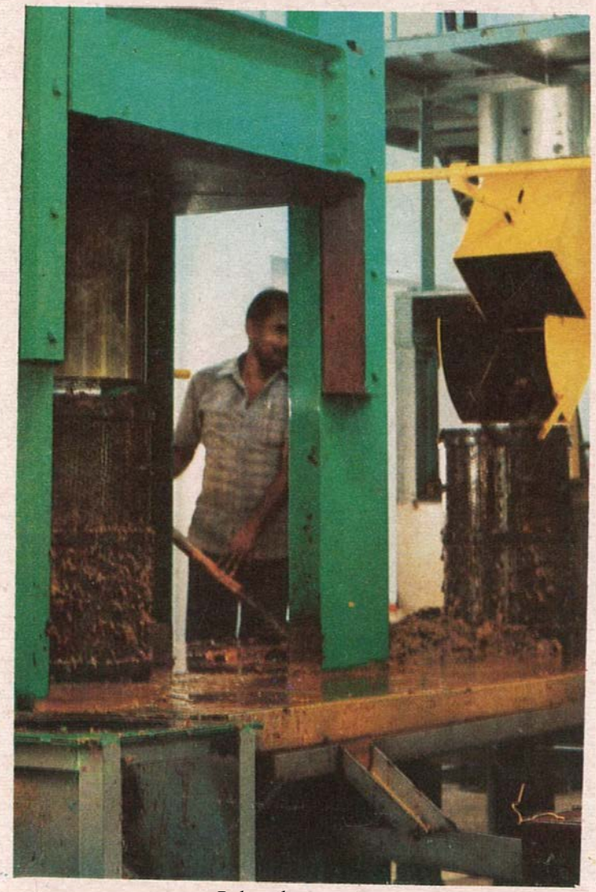
CFTRI, Mysore has developed technology for decortication of sunflower seeds to increase the availability of oil by 5%. The oil, wax-free and lighter in colour, has better marketability. The total package on sunflower seed processing has been released to: M/s. Godrej Soaps Limited, Bombay; Karnataka Oilseeds Producers Assn., Bangalore; Tamilnadu Agro-industries Corp., Madras; and Indian Tobacco Company.

Technology for palm oil processing

The demonstration plant of RRL (Trivandrum) for the processing of raw palm for edible oil has been commissioned at Palode. It processes 0.5 MT FFB per hour (500 kg. palm oil per shift). The plant will function as a national facility to demonstrate palm oil extraction technology and is expected to stimulate oil palm cultivation in the country.

Large scale storage of oil seeds

SERC(G) has given a modular design of a 1000 tonnes capacity storage barn to NCDC. Installation of the model structure at Merta city (Dist. Nagaur, Rajasthan) through Rajasthan Rajya Sahakari Kriya Vikriya Sangh Ltd., at their Mustard Oil Plant has been taken up.



Palm oil processing

Improved Oil Expeller (MERADO, Ludhiana)

Crushing Capacity — 10 tonnes of oilseeds/day

Seeds that can be processed — Mustard/Toria/ Rapeseed, Groundnut, Sunflower etc.

Economics

* Processing cost is 44% lower as compared to the cost using single chamber conventional oil expeller and 40% lower as compared to the cost using double chamber conventional oil expeller.
* Only one crushing of seeds required in Modem Expeller (to achieve 7.5% oil in cake) in comparison to 4&2 successive crushings required in single chamber & double chamber conventional oil expellers respectively.
* Longer life (10 weeks) ensured for worm & cage bar assemblies in comparison to the life (2 weeks) of the conventional oil expeller assemblies.
* Low power consumption.



Prototype of the improved oil expeller designed and devet ped at MERADO, Ludhiana

WASTELANDS DEVELOPMENT

Under a collaborative research programme of field studies for wastelands .development between the U.P. Bhumi Sudhar Nigam, and NBRI, distillation, of aromatic grasses was carried out and about 3.8 kg vetiver oil, 6.7 kg lemongrass oil and 0.8 kg palmarosa oil were produced.

Usar Land Reclamation and Utilization Project, Aligarh (NBRI)

Wheat production increased from 1.50 t/ha (1987) to 2.32 t/ha (1988). To evolve a cost effective cropping pattern for reclamation and management of such alkaline wasteland, *Chamomilla recutita,* was cultivated on 5 ha land. It produced 4.02 tonnes (dry weight) of flowers and gave returns of about 5-6 times more than season's traditional wheat crop.

During the period under report, 25 tonnes of paddy was produced from 7 ha. In the soil reclaimed by now, maize, jo war, mustard and sugarcane were cultivated successfully as trial crops.

GANGA ACTION PLAN

Processing Package for Waste Treatment at Swargashram

A cost effective treatment system comprising Rotating Biological Rope Contactor, developed by NEERI has been designed for treating wastewater from Swargashram near Rishikesh. The design is on modular mode to cater to varying waste water flows of a floating population. The effluent from the system will be used for irrigation of lawns and gardens in and around the Ashrams. U.P. Jal Nigam has taken up the construction of the treatment plant as per NEERI design.

NATIONAL S&T PROGRAMMES

Superconducting Quantum Interference Device (SQUID)

CSIR is presently involved in the development of a SQUID as an inter-laboratory project, under the National Scientific & Technological Programme on High Temperature Superconti-vity, with NPL as the coordinating laboratory. A short-term programme aims at the development of a demonstration SQUID based on bulk materials by March 1990, but the long-term objective is to make a device using thin films of high temperature superconductors. A detailed study of grain boundary Josephson junctions has been made in bulk samples. DC SQUID like behaviour in voltage vs Flux curve has been observed in a double-junction geometry made out of bulk material.

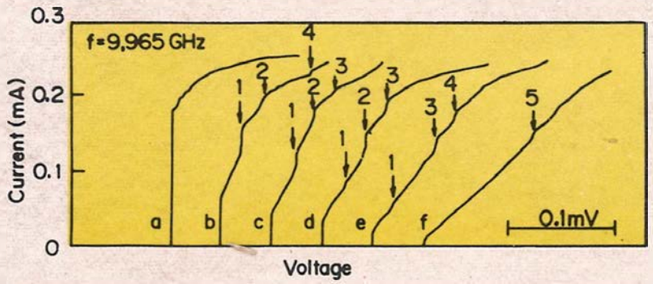
NPL Aeronomy Payload on SROSS-C Satellite

ISRO is planning to launch a simpler (100 kg class) satellite (SROSS-C) with the next ASLV mission, before launch of the mirin Aeronomy Satellite-SROSS-3 (150 kg class). The retarding potential analyser (RPA) payload of NPL is the only aeronomy experiment selected for this mission.

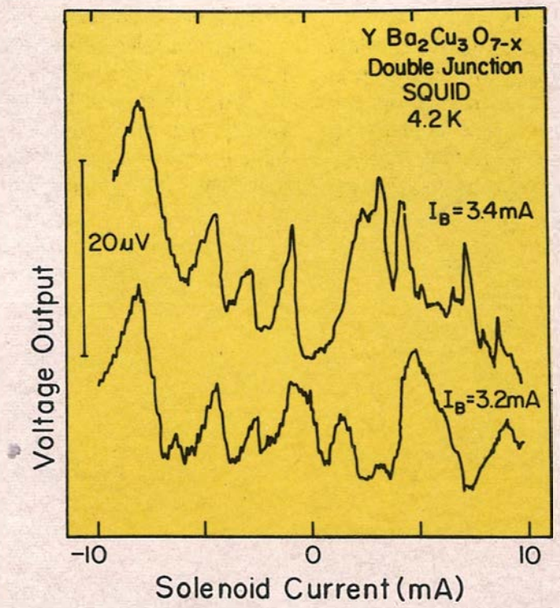
Configuration

Weight : 100 kg

Shape	: Octagonal prismois with 8 body-mounted solar panels. (No deployable solar panels).
Size	: 1100 mm height x 700 mm A/F size of octagon.
Spin rate	: 2 rpm.
Spin Axis	: Parallel to one of the lateral axes and perpendicular to Axis the orbital plane.
Orbital inclination	45 degrees
Orbit	: 400-500 km (circular)
Lifetime	: One year approximately
Power Generation	: 36 W (against 90 W in SROSS-3)



Observation of AC Josephson Effect due to presence of grain boundary Josephson junction in Bi-Sr-Ca-Cu-O bulk samples



Observation of Superconducting Quantum Interference Effect (SQUID behaviour) due to grain boundary Josephson junctions in Y-Ba-Cu-O bulk Superconductors

Time Schedule

* Engineering Model Fabrication	: March-June 1989
* Qualification and Environmental Testing	: July-August 1989
* Flight Model Fabrication	: Sept.-Nov. 1989
* Integration with Satellite	: Dec. 1989
* Launch of SROSS-C	: June 1990

* The engineering and flight models of RPA payload will be fabricated by the NPL scientists and engineers at IS AC, Bangalore.

Antarctic Research

Direct UV radiation measurements were made by NPL at Maitri at 220, 300 and 310 nm using direct UV photometer. These observations coupled with atmospheric turbidity measurements done by measuring solar radiation at 368, 500, 675 and 778 nm arc desired inputs to the determination of total Ozone.

Minor constituents of Antarctic atmosphere in relation to ozone depletion phenomenon were studied by collecting air samples in stainless steel samplers. These samples are being Analysed for CH^, CO, CO_2, NO_2 and freons.

VLF phase tracking equipment was set up at Maitri to monitor OMEGA, reunion signals, round the clock, round the year. These measurements combined with similar and simul-

taneous ones at NPL (high and low latitudes) will provide useful inputs to the study of ionospheric 'D' region and related events.

A comparative study by NIO on the production of krill in relation to the distribution and abundance of consumer species of seabirds and mammals, revealed that annual variability in the sea ice coverage rather than the standing crop of krill, was the limiting factor.

Chi a and primary production measured at station in Polynya, were almost equal to those observed in the coastal waters of continents.

Rock samples were collected from Gruber Massif, Humboldt Area, Balasrufdjellet Nunatak and Shirmacher Range by NGRI for petrography, major, minor, trace and rare earth element analyses, geochronology, paleomagnetic studies and P-T estimates.

PHYSICAL, EARTH & MARINE SCIENCES

STANDARDS

Effect of Working Media in Determination of the Effective Area of the Piston Gauge (Pressure Standards)

The metrological characterization of the controlled clearance piston gatige in the pneumatic pressure region by measuring its fall rate as a function of the different working fluids, ambient temperatures and rate of rotation of the piston clearly indicates the superiority of one type of fluid over another for improving upon the uncertainty in the pressure measured by these guages. This work is among the first to show experimentally that it is very essential to use the same pressure fluid for calibrating the transfer standards as the one used in characterising the Primary Standard (Controlled Clearance Piston Gauge); otherwise the transfer standard may have more uncertainty in its effective area measurement.

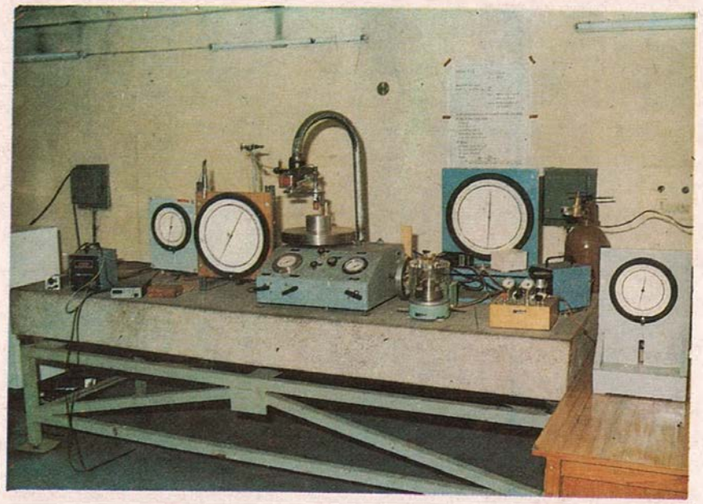
Three new standard materials have been released by NML during the year :

Nickel Steel No. 21.2
Low Alloy Steel No. 23.4
Low Alloy Steel No. 23.5

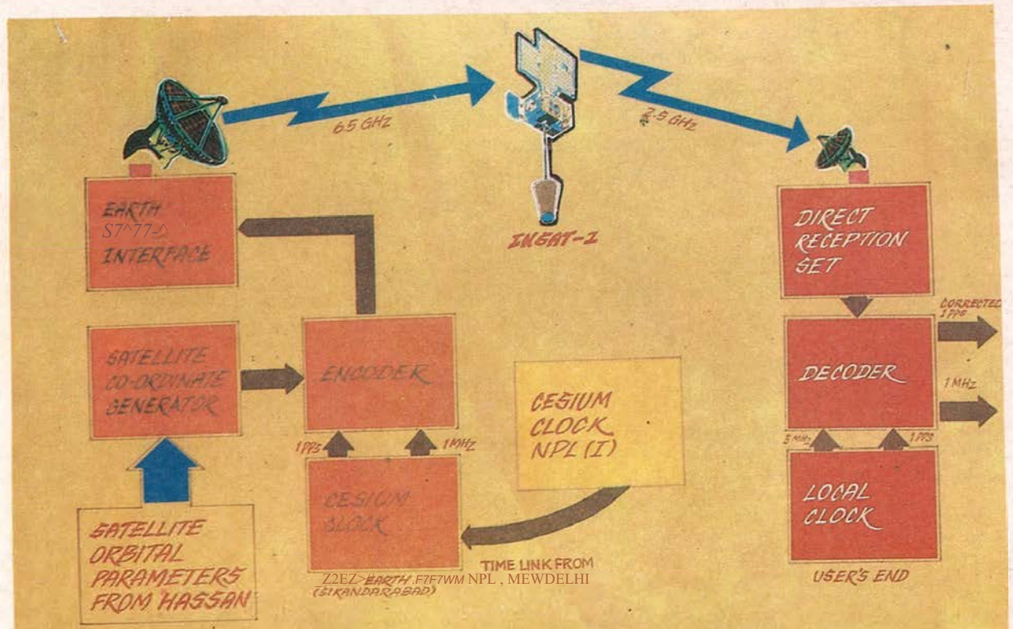
So far NML has released 24 standard materials which are of vital importance to metallurgical and mineral industries for rapid and accurate analysis of raw materials and finished products.

Time Services via Indian Domestic Satellite INSAT

NPL is now regularly transmitting Standard Time and Frequency Signals (STFS) via the Indian Domestic Satellite INSAT—1 B. This service is provided via a Radio Networking Channel with a downlink of 2599.675 Mhz. The uplink to the satellite is a code format at 6 GHz carrying information on Time as



Controlled Clearance Primary Pressure Standard to measure Pneumatic Pressure upto 60 bars



STANDARD TIME & FREQUENCY SIGNAL DISSEMINATION VIA INSAT-1

Indian Standard Time (1ST) and the instantaneous position coordinates of the satellite. This uplink takes place from Delhi Earth Station (DES) at Sikandrabad, U.P. The satellite coordinates are computed from the six orbital parameters obtained from the Master Control Facility (MCF) at Hassan, Karnataka, almost once a week.

The receiving set up is a Direct Reception set (DRS) alongwith an NPL designed and developed Decoder. The Decoder extracts the coded information, uses the satellite co-ordinates information alongwith the transmitter (DES) and the user co-ordinates to make on-line propagation delay corrections. It is a completely automatic system capable of synchronizing the user's time to that of NPL standards to within 25 micro-seconds with a precision of 1 microsecond and frequency to within few parts in 10^. The know-how of the Decoder has been transferred and the receiver system is now available commercially.

STFS via INSAT are now being utilised or are in process of being utilised by several organisations in the country such as the Department of Electronics (ERTLS), Radio Astronomy Centre, Physical Research Laboratory etc. The other major users who have shown keen interest are seismological stations for earthquake detection, Central Electricity Authority for fault detection, Indian Space Research Organisation, All India Radio, Telecommunication establishments etc.

This STFS service by NPL is an outcome of experimentations over several years with national and international satellites such as symphome, INTELSAT, APPLE and is similar to the service being provided by the U.S.A, via satellite GOES, the only other such service now in operation.

RADIO AND SPACE PHYSICS

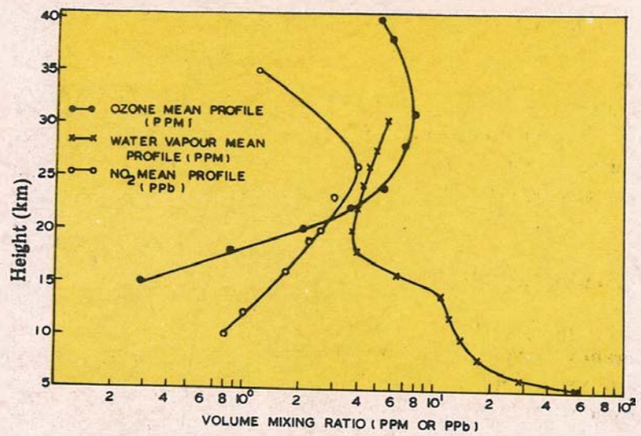
Laser Heterodyne System

An infrared tunable CO2 laser heterodyne system has been set up at NPL to monitor vertical profiles of minor constituents such as ozone, water vapour, nitrogen dioxide, CIO, NH3, CFCs, SO2, etc. The system has ultra-high spectral resolution, high quantum detection efficiency and good signal-to-noise ratio. For the first time, this type of system has been used successfully in the country to get tropospheric and stratospheric height profiles of ozone, water vapour and nitrogen dioxide.

An appropriate inversion technique has been developed and tested for retrieving the height profiles of various trace species, using the measured time profiles by laser heterodyne system.



Laser Heterodyne System



Mean volume mixing ratio profiles of Ozone, Water Vapour & Nitrogen Dioxide obtained by the Laser Heterodyne System

ELECTRONIC DEVICES AND SYSTEMS

Microprocessor - Based Temperature Data Acquisition, Monitoring and Control (Micro-Teimac) System for Energy Conservation and Improvements in Processing in the Sugar and Allied Industries

(Partially funded by the Department of Electronics)

An important variable which needs continuous measurement and monitoring is the temperature since it affects the final product and if properly controlled, can lead to energy saving in the plant. There are about 65 points in a typical sugar plant which need measurement, indication, monitoring and control. The Micro-TEIMAC system developed by CEERI has been successfully tried at Kisan Sahakari Chini Mills Ltd., Anoopshahar, U.P. The Micro-Teimac System consists of :

* 4‘/2 digit industrial grade Temperature Indicator
* Low thermal offset multichannel Scanner
* Monitoring Panel (24 points)
* Pneumatic Controller (Ex Juice Heater)
* Multi-channel controller (sixteen points)
* Stepper Motor Controller (Ex Desuper-heater).

Instrumentation standard 4-20 mA output control signal is provided for 16 channels and it can drive up valves, stepper motors and help operation of manual valves through CSDI.

Special Advantages Over Existing Technology

* The system is reliable and accurately measures temperature with a resolution of 0.1 degree C, corresponding to 4 mV, in sugar factory environment from a distance of 100 meters. Such a resolution is suitable for digital control of production.
* Reliable/Field proven/Flexible and industrial Grade System.

Potentialities

Apart from optimising temperature dependent sugar recovery process, also leads to saving of 2% of energy; suitable for other industries also, eg. Cement, Food etc.

Monolithic Power Darlington Transistor for AC Drive in Vehicle Transportation

CEERI has developed a Monolithic Power Darlington Transistor for vehicle transportation.

It is a suitable component for electronic power control systems and is being used in CEERI PWM AC motor drives for electric vehicles. The fabrication is based on high voltage diffusion technology. The device is likely to be manufactured by BHEL, Bangalore.

Superior Performance over International Devices

The CEERI Monolithic Darlington transistor provides superior electrical performance over existing international devices; its features are :

* Low saturation voltage 1 volt - at 100 Amp.
* Maximum power dissipation - 450 watts and high junction temperature - 150 degree C.
* Improved switching speed and good RBSOA performance
* Low thermal resistance -0.06 degree C/W.



100 Ampere Monolithic power darlington Transistor with improved contacts for A.C. drives

Development of Power Hybrid Microcircuits for AC Motor Drives

Recognising the importance of Hybrid Microcircuit Technology over PCB technology in terms of reliability, size performance, weight etc., CEERI has developed two different types of Base Drive HMCs to drive 100 Amp. transistors and 300 Amp. transistors.

In 300 Amp. base drive HMC, high power resistor (3ohm, 15 watt), medium power transistors and other low power resistors and chip capacitors, have been integrated on a l”xl.25”x0.025” alumina substrate. In order to dissipate 25 watt from the circuit, the thick-film HMC has been mounted on a nickel plated copper base plate of size l”xl.5”x0.1” encased in aluminum package. Both these HMCs have met electrical and environmental specifications.

Salient Features of Power HMCs

Superior performance over PCB
Smaller size and weight
High reliability
Low cost
Secrecy
High Power Dissipation 25 watt.

Development of HMCs for INSAT-II

Three different types of HMCs namely Relay Driver-1, Relay Driver-2 and Remote Decoder Circuits (Multilayer) were developed. All these HMCs are meant for high reliability space application and hence are fabricated as per MIL-M-38510 F fabrication procedure. 83 Nos. of Relay Driver-2, and 44 Nos. of Remote decoder circuits were delivered to IS AC, Bangalore for screening. These HMCs were rigorously tested in accordance with MIL-STD-883C Test Method 5008.1. They met all the specifications and are being used for ETM model of the satellite.



HMCs developed for INSAT-II(ETM)

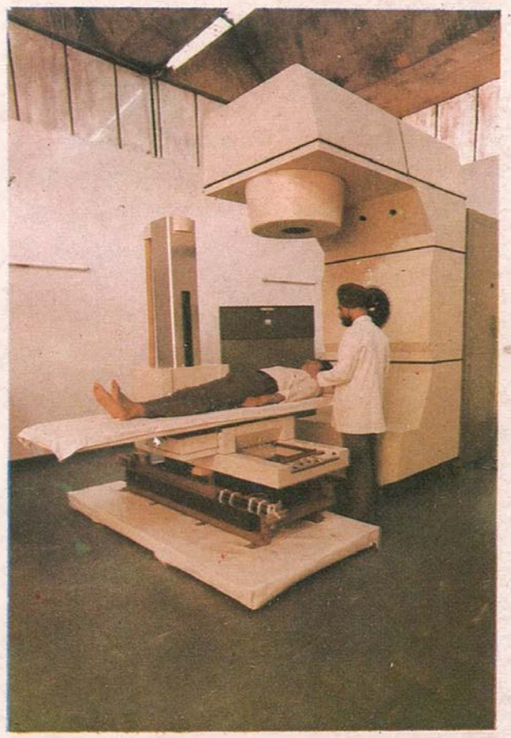
INSTRUMENTATION

4 MeV Linear Accelerator for Radiation Therapy

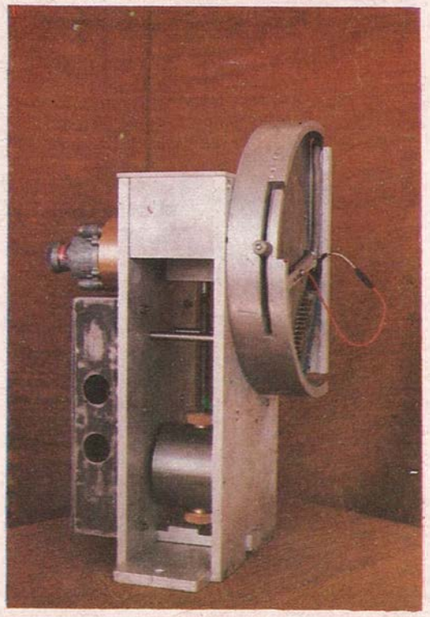
A 4 Mev Medical Linear Accelerator machine has been developed for the first time in the country under the sponsorhsip of the Dept, of Electronics, Government of India. This is a collaborative project of CSIO, SAMEER, Bombay and PGI, Chandigarh.

This machine is used for radiation therapy of cancer patients. It delivers a high energy uniform X-ray beam to the tumour, at the same time, causing minimum damage to the surrounding healthy tissues and makes use of the fact that many malignant tumours are generally more sensitive to radiation than normal cells.

The complete machine consists of the following subsystems :



4 MeV Linear Accelerator



Vertical Profile Meter

(i) the linear accelerator (Linac) X-ray source, (ii) Microwave source, (iii) Modulator & controls, (iv) Gantry & collimator assembly, (v) Treatment table, and (vi) Microprocessor controls.

Medical linac is a high precision machine set to deliver the dose accurately within a specified area. The gantry, weighing about 4.5 tonnes is so designed that the isocentre lies within ± 1mm radius in all positions of the gantry, collimator and patient couch.

The machine has been tested upto a dose rate of 190 R/min. Further testing at high levels of dose rates will be done at PGI, Chandigarh. It is likely to be installed there shortly.

The cost of similar imported machines ranges from Rs.85 lakh to 100 lakh.

Atmospheric Corrosion Monitor

A portable atmospheric corrosion monitor has been developed by CECRI for measuring the corrosivity of environment/atmosphere instantaneously.

Vertical Profile Meter

Inventorisation of highways: automated measurement of vertical profile (gradients)

The geometry and riding quality of road sections have very notable effect on the travel speeds and vehicle operating costs. CRRI has already produced indigenous devices for the measurement and control of riding quality. As a follow-up activity, an automatic device called vertical profile meter has been developed for the measurement of up and down gradients of road sections upto as much as plus or minus 18 per cent. The device can be fitted in a vehicle to make measurements at normal travel speeds. The road organisations would find the device very useful for inventorising the geometric characteristics of their roads.

Nephelometer for Atmospheric Dust Measurements

The development of Nephelometer was funded by the Department of Environment (DoEn), Govt, of India. The instrument, based on light scattering, is highly useful in continuous measurement of atmospheric concentration of dust levels, and hence for air pollution monitoring.

Digital Cassettee Seismograph

GSIO has developed and fabricated a Digital Cassette Seismograph around C-MOS technology based microprocessor. The instrument is capable of operating in a network of seismic array at remote areas. It is far better than the analog version in terms of count of events, even triggering, computation of energy distribution, interpretation of information in alphanumeric form and provides chronological seismic records.

Seismic Data Retrieval Unit of the Seismograph is a companion playback Plotter Unit to retrieve and decipher the seismic information recorded on the cassettes which are collected from a number of remote stations at the observatory. This unit produces the hard copy of seismograms along with necessary information required by the seismologist to analyze the events. The information may also be transferred to a main frame computer.

Both the above instruments have been developed for the first time in the country and are based on technology available at international level.



"Detection Kit" for narcotic drugs

A Detection Kit for narcotic drugs

Illicit trafficking of narcotics has assumed alarming proportions and become a serious social problem in the country. For detecting narcotic drugs, special types of imported detection kits are being used by the Narcotics Control Bureau. The task of developing such a kit indigenously was entrusted to NCL, Pune and the work was completecj in a record time of three months.

The detection kit developed by NCL consists of a small-box containing a few chemical reagents, a couple of test-tubes, a small plate, two glass rods and two glass droppers. Along with the kit, instructions for use, testing methods and colour charts are provided. With the help of this kit, it is possible to identify the suspected narcotic. The know-how of assembling the kit has been transferred to the Hindustan Antibiotics Ltd., Pune for use by the Narcotics Control Bureau. The NCL-HAL kit costs considerably less than the imported kit. The production of detection kit has commenced at HAL in collaboration with NCL.

Blood Analysis Equipment

The development by CSIO of the Blood Analysis Equipment for analysing various blood parameters like Glucose, urea, Albumin, Proteins etc. has received the NRDC Award. The device replaces the conventional source df visible light in the standard meters by light emitting diodes. Elimination of filters and low power consumption enable the equipment to be operated on batteries.

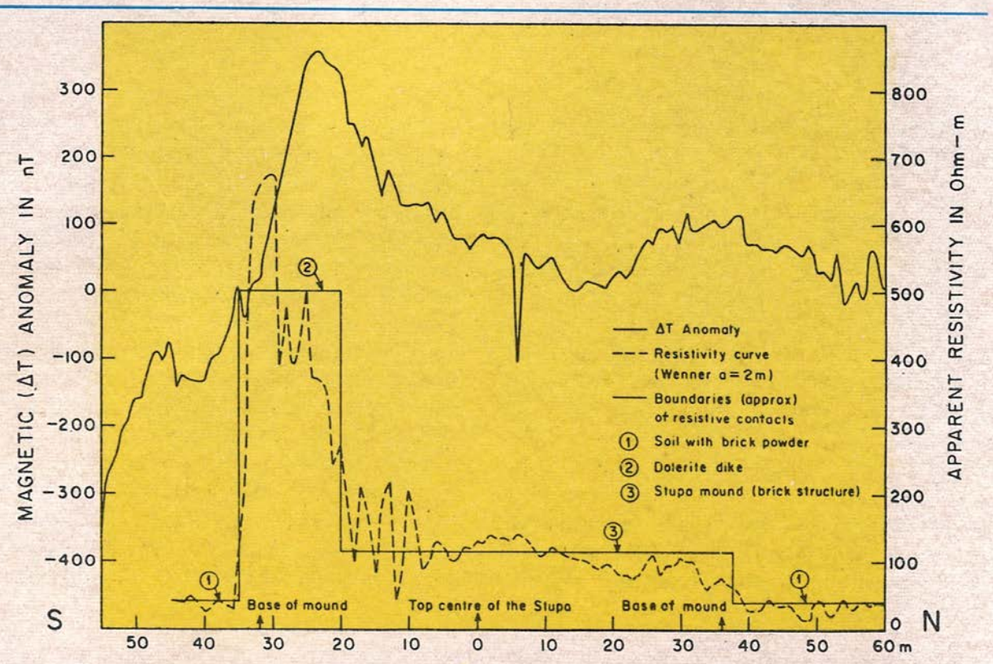
Water Analysis Kit

A portable water analysis kit composed of a colorimeter and small incubator fabricated at ITRC is useful for carrying out simple bacteriological tests for water safety and simple chemical tests for nitrate, fluoride and iron. This Centre is about to enter into a programme of evaluation and assessment to be carried out by Public Health Engineering Departments. As agreed at the seventh meeting of the S&T Steering Committee, an order has been received for 50 units. Each kit will be supplied along with reagents for a hundred tests. The first consignment of kits is under quality trial at ITRC. The U.P. State Jal Nigam has agreed to carry out an assessment of the performance of the kit in the field. Many entrepreneurs are interested in the manufacture of this kit.

GEOPHYSICS

Archaeological Studies in A.P.

An experimental geophysical survey employing magnetic, electrical resistivity and electromagnetic methods, has been carried out by NGRI to locate targets of archaeological interest, near Nelakondapally village of Khammam district, Andhra Pradesh. In consultation with the State Department of Archaeology and Museum, four sites were selected for this experimental work. Test surveys over known archaeological remains (sites 1 and 2) indicated observable geophysical responses. Extensions of the remains of foundation of brick walls could be demarcated by magnetic and electrical resistivity surveys and partial excavation of the anomaly zones in site 3 showed up the remains. In the opinion of the archaeologists of the Department, the discovered walls are a part of the dwelling complex belonging to the period between 2nd and 6th centuries A.D. A granite disc and some fragment of pottery associated with a limestone stump, belonging to the same period, have been discovered by magnetic and electromagnetic methods in site 4. These targets, excavated partially, are found to have significance in understanding the culture and history of this area during that period. The experimental survey demonstrated the usefulness of employing geophysical methods in pinpointing targets of archaeological origin.



Magnetic and resistivity anomalies along the N-S Profile over the Mahastupa

Seismic Hazard Evaluation

A first order velocity model of Northeastern India has been obtained through simultaneous inversion of earthquake data for the hypocentral parameters and velocity model.

These new observations by NGRI offer preferential support to the model of vertical sinking lithosphere in the India-Burma border region atleast in the area lying between 24 and 28 degrees north latitudes whereas the region southwards has a more or less beni off-zone-like subducting lithosphere.

Magneto Telluric Studies

From a study of the M.T. anomalies, it is clearly established that Deccan Traps can be very effectively mapped using magnetotellurics.

Modeling results indicate that the lithospheric electrical structure in the trap region is characterised by the possible presence of electrically conducting layers at the base of the crust, with thickness around 5-10 km and resistivities around 100-200 Ohm.

Geo tomography

A study of the structures and dynamics of the Southern Indian shield through large scale 3-D Imaging technique, was completed by NGRI. The study indicates that the high velocity upper mantle heterogeneity identified beneath the South Indian shield, coinciding with the granulite terrain, is distinctly different from the Deccan volcanic province, in the depth range of 80-400 km.

OCEANOGRAPHIC RESEARCH

High Precision Gravity Data on Bombay High for ONGC

ONGC approached NIO to collect high precision gravity data in the Bombay High and adjoining areas for locating oil bearing strata. NIO collected high precision gravity data for about 7000 line km. The preliminary appraisal of the gravity data brought out significant information. A prominent Free Air Gravity anomaly low centred around 19° 30'N and 70° 10'E was observed. This low anomaly approximately coincides with the Bombay High structure where gravity high is expected under normal situation. This information will help in better understanding of the geology of the oil bearing Bombay High and adjoining areas.

Physical Oceanography

Statistical studies such as Markov modelling were carried out on the grade and abundance data of nodules in the Central Indian Ocean Basin by NIO. The studies suggest that the grade does not vary over 27 km. distance and at least one third of the total explored areas has nodules with a cut off grade (Ni+Cu+Co) of 2%. Studies by NIO on volume transport across the central Bay of Bengal indicate a net northward flow of 5 svedrups adjoining the east coast of India. This is in consonance with the satellite observations as well as the findings from the thermal structure off 10 deg. N. The region between the Andaman Sea and Madras is found to have very high cyclone heat potential which aids in the accelerated growth of tlic atmospheric disturbances during post monsoon season.

The studies on air-sea interaction processes in the Arabian Sea in relation to monsoon revealed that the net heat gain during 1988 monsoon (August-September) over the southwestern Arabian Sea was less than normal. This low heat gain could be due to the high evaporation rates which increased by about 80%. The seasonal surface cooling was lower than normal, inspite of low heat gain suggesting the importance of advective processes. The evolution of heat budget parameters indicate higher latent heat flux/evaporation rates during the premonsoon than the monsoon season.

The conspicuous low monsoonal rainfall along the west coast of India in 1986 has been found to be associated with anomalous low SSTs in the eastern Arabian Sea. Moreover, the anomaly of total heat loss from the sea surface was positive in the southern Arabian Sea. These together suggest that the energy-exchange in the eastern Arabian Sea influences the coastal rainfall pattern on intra-seasonal scale.

Chemical Oceanography

The non-conservative nature of dissolved organic carbon in the Arabian Sea has been proved through a one-dimensional advection — diffusion model. The organic carbon decomposition has been found to contribute a minimum of 64% to the total CO2 by regeneration process.

A study on salinity, temperature and biomass and composition of bryozoans on aluminium and fibreglass substrates revealed that salinity played an important role in the settlement of these organisms. Similarly, salinity appeared to be an important factor influencing the settlement of ascidians.

The data collected on microfouling upto 4000 m, in the Arabian Sea show that in the near-shore region the microfouling biomass was more than that in the oceanic region. The studies on corrosion behaviour of various metals indicated that at greater depths the extent of corrosion of mild steel and brass increased, whereas in the case of stainless steel and aluminium it decreased.

Bioactive Substances

Ten new soft corals were discovered by NIO. Isolation, characterization and synthesis of active principles - 2 Benzoxazolinone (analgesic and CNS), Benz ox azin oids (anti-inflammatory), acetoneamines (hypotensive), aurantiamides (spermicidal), cholestane 3, 6 dione (spermicidal and antibacterial) were carried out. New toxic sapogenin has been isolated from sea cucumber *Actinopyga mauritiana* and tentatively characterized. Forty-six isolates of marine microbes were used for the first time to test antibiotic activity.

Marine Archaeology

The submerged channel of the river Gomati on the banks of which the legendary city of Dwaraka was built, has been explored. The channel was found to be 400 m wide. On its left bank there were remains of a fort wall in 3 patches as also a bastion, confirming that the ancient city of Dwarka was built on wave cut benches on both the banks of Gomati. The *insitu* position of. the structures suggests that the total rise in sea level during the last 3500 years may be about 12 m. It is also established that the ancient Dwaraka extended 1.75 km seaward of present shoreline.

CHEMICAL SCIENCES

CHEMICALS

NCL has developed an innovative non-phosgene non-MIC route technology for the production of Carbaryl, a carbamate pesticide largely in use in agricultural operations. Excel Industries Ltd., Bombay, has shown interest in putting up a pilot plant to be followed by a commercial plant, for utilization of NCL technology. An international patent has been filed.

RRL, Hyderabad has developed anew route for chloropyriphos, a broad spectrum organo-phosphorus insecticide for cotton, rice, ground-nut, maize and vegetables. The new route is better than the presently available Dows Chem. technology in the world. This has been introduced by licensing to Vantech Pesticides Ltd., Hyderabad for a 200 TPA plant costing Rs.2.0 crore. A second plant will be installed by NOCIL, Bombay with a capacity of 500 TPA and turnover of Rs.15.0 crore. The know-how for the raw materials used in this technology can also be provided by RRL, Hyderabad.

An alum plant was recently commissioned for commercial production. Technical know-how for this unit with a capacity to manufacture 30 tonnes/day of alum, utilizing bauxite from Chakkar area of Jammu region, was provided by RRL, Jammu. The firm was given demonstration of the process, and was helped in the assessment of raw material and training of their personnel for quality control. Trial runs were carried out under the supervision of RRL scientists and engineers.



Multipurpose Pesticide Plant

Tuftan

"Tuftan", a leather chemical, based on poly-amide resin, which fixes more chrome on leather in the tanning process and therefore considerably reduces chrome going in the effluent, imparts intense and uniform dyeing and improved overall properties of leather. It is also used as a retanning cum filling agent. This development by CLRI has bagged the NRDC Award also.

Leather Chemicals

Technologies have been generated at CLRI for the preparation of a range of phosphorylated, phosphorylated-cum-sulphated and sulphited fatliquors based on marine and vegetable oils. These fafliquors are much superior to the conventional sulphated and sulphited oil fatliquors as they contain the reactive phosphate group and form electrolyte stable emulsions and can be employed advantageoùsly for the manufacture of tight grained leathers with a high degree of softness.

A novel process to manufacture high performance acrylic soft binder useful for making softy clothing, gloving and upper leathers has been demonstrated successfully at 100 kg level in the pilot plant of CLRI. The commercial production of this binder is likely to commence soon.

Poly tan

An acrylic syntan based on the graft copolymerisation of an acrylic ester and acid monomers on to sulphated oil using free radical initiators has been studied by CLRI. This syntan has been tried in retanning of chrome leathers. Because of the hydrophobic/hydrophillic functionality coupled with sulphated oils in this product, the polymer selectively fills up the belly portion and gives fullness and softness to leather respectively. This process has been scaled up at 65 kg level and the field trials in the tanneries are under progress. A patent on this process technology has been filed.

With a view to developing pesticides from natural resources, a successful effort has been made to prepare an effective insecticide from the Indian neem plant. A novel process to obtain an insect antifeedant and an insect, growth regulatory fraction from neem, named as Vepacide, has been developed by RRL, Hyderabad.

Food Grade Hexane

IIP has developed a process for the manufacture of Food Grade Hexane by the solvent extraction method. The process is based on liquid-liquid extraction with sulpholane of crude distillation cut of 63-69°C. The process know-how has been licensed to Madras Refineries Ltd. and Bharat Petroleum Corporation Ltd., (BPCL) on a non exclusive basis. BPCL is proposing to setup a plant of capacity 25000 TPA.

The Institute has also developed a laboratory-scale process for Food Grade Hexane using N-methyl pyrrolidone as the solvent for which an application for Indian patent has been filed. Scale-up studies of the process are under way in collaboration with a refinery.

Peptides and Thiopeptides: New Synthetic Methodology

A simple method for producing amides of nitro-acetic acid at room temperature has been developed by NCL. The reaction has been extended to the nitroacetylation of L-proline ester. The synthesis is thus capable of leading to peptides with glycine at the N-terminus. The nitro group acts as a latent primary amine and also activates the adjacent methylene group.

Using a similar methodology, nitroacetic acid thio ami des have been successfully synthesized. Regiospecific synthesis of thiopeptides is thus possible by this route.

Bio-organic Chemistry

RNA Synthesis: Synthesis of $ (AAGGCCUU)^' and (AAGGCCUU)^ i§ j_n final stagey Work on solid phase synthesis has just begun at NCL.

Modified Oligonucleotides : Cyclo anhydro adenosine has been synthesized and successfully incorporated into oligonucleotide se-

quences. Synthesis of 2:2'-anhydro cyclo uridine, and arabino uridine has also been completed. Synthesis of 6:2'-anhydro cyclo uridine is being carried out. A similar methodology is being extended at NCL to synthesis of analogous guanosine and cytidine derivatives.

DNA Synthesis : Several DNA fragments ranging from 10 to 18 mers have been synthesised successfully using manual solid phase synthesiser. Some modified nucleotides have been successfully incorporated into the sequences. These sequences have important relevance to biological studies. Their biophysical properties such as melting, UV, fluorescence, etc. are under investigation at NCL.

Catalysis

Photocatalytic reduction of molecular nitrogen to ammonia with particulate systems Cds/Pt/RuO2 ni conjunction with Ru catalyst was achieved by CSMCRI. A modification of the photocatalyst by doping it with Ag has increased the turnover number. The same photocatalyst was also used for reduction of CO2 which got reduced to HCOOH, HCHO, CH3OH, CO and CH^ efficiently. Pt/TiO2/RuO2 and its doped catalyst (with Fe2Og) has been shown to oxidize the coordinated nitrogen to corresponding nitrogen oxides.

All the parameters for making the deoiler in the pilot plant scale (100 kg/batch) were optimised and 4 tonnes of the product was prepared at the cost of ONGC and OIL and the same was tested at different oil fields of the region. The process was then licensed by RRL, Jorhat to M/s Poly Products (Chemicals Division), Guwahati for commercialisation.

A draft report for the proposed pesticide complex for Bangladesh for manufacture of DDVP and Phosphamidon in an integrated plant was prepared jointly by RRL, Jorhat and IICT, Hyderabad. The assignment was sponsored by the Ministry of External Affairs, Govt, of India through NRDC. The draft was submitted to NRDC for follow up action.

The know-how package on the diosgenin process based on pilot plant level development including scale up studies was handed over to Tripura Forest Development & Plantation Corpor°tion Ltd. (TFDPC), Agartala. The basic design for 10 TP A diosgenin plant for TFDPC was also taken up and the report was handed over.

DRUG DEVELOPMENT

A technology for Etoposide has been developed and streamlined by RRL, Hyderabad. Etoposide is an anticancer drug used especially for treatment of lung and testicular cancer. This drug, at present being imported at a high cost, involves a highly chemistry-intensive process. The process has been successfully demonstrated to the sponsor for commercial exploitation.

Promising synthetic compounds/plant products/vaccine under development	Laboratory	Current status
Chandonium iodide (neuromuscular blocking agent)	CDRI	Extended phase II clinical trials continuing.

Promising synthetic compounds/plant products/vaccine under development	Laboratory	Current status
Centpropazine (antidepressant)	CDRI	Six-month toxicity studies in rats and monkeys completed and the data are being submitted to the Drugs Controller (India) for permission to undertake phase III clinical trials.
Compound 80/53 (antirelapse antimalarial)	CDRI	Single dose phase I clinical trials completed; no adverse effects observed.
Arteether (antimalarial)	CDRI/ CIMAP	Arteether, a derivative of artemisinine, has been cleared by the Drugs Controller (India) for phase I clinical trials.
Mycobacterium habana (antileprosy vaccine)	CDRI	Permission from DC(I) to initiate phase I/II clinical trials is awaited. In a study conducted at the National Institute of Medical Research, Mill, Hill, London, both killed and gamma-irradiated M. habana vaccines provided protection comparable to gamma-irradiated M. leprae challenge in the mouse foot-pad test system.
Compound 84/246 (immunoadjuvant)	CDRI	Efficacy and toxicity data submitted to DC(I) for permission to initiate phase I/II clinical trials.

POLYMER SCIENCES

Speciality Leathers

Water resistant upper leathers for mountaineering shoes have been developed by CLRI and sent for field test. They showed only 10% of water absorption under dynamic conditions.

Speciality leathers with high heat resistance as required by Railways have been supplied and specification for the same has been laid down.

As a collaborative project with CLE & Bailey, Switzerland, sole leathers have been produced from Indian buffalo hides with reduced water absorption and increased abrasion resistance, using newer types of syntans developed by CLRI. These samples have been sent to Kanpur where concurrent experiments arc being carried out by Bailey shoes.

Under the Department of Science and Technology (DST) sponsored programme, NCL undertook the work on development of engineering components for two wheelers. The project is the first of its kind undertaken at NCL, in terms of the participation of end user (Bajaj Auto Limited, Pune), and materials

manufacturer (B.M. Thakkar and Company Private Limited. Pune) and NCL, representing an attempt at the development of FRIP-based substitutes for metal replacement in two wheelers.

The two components developed viz. an injection moulded rotor fan and a reed valve base have passed stringent performance tests for thermal resistance, flexural'strength, impact strength and other field trials.

NCL has undertaken a project for the development of drag reducing oil soluble polymers (DROP) for crude oil and its products transportation, in collaboration with ONGC, Baroda, and Lubrizol India Limited, Bombay respectively. The polymeric additives when incorporated in very low concentrations in crude oil or its products like diesel and kerosene, are known to reduce the drag in pipeline transportation making it possible to transport more crude oil and its products through the existing pipelines with the existing pumping arrangement. NCL has successfully developed a drag reducing polymer (DROP) which reduces drag upto 80% and is effective at concentration as low as 50 to 100 parts per million by weight in some products. This performance is considerably better than that achieved with the imported commercial additives.

PETROLEUM REFINING

Petroleum and Petrochemicals

The CSIR consultancy project for ONGC on 'Optimization and transportation of high waxy crude through submarine pipeline' has been completed and the report sent by RRL (Jorhat) to ONGC.

Know-how on SWAT-104 - a pourpoint depressant ' developed by RRL (Jorhat) for crude oil transportation through pipeline was released to M/s HICO Products, Bombay and the firm has started commercial production under the trade name of HISW AT-104.

A new deoiler additive has been found to be very effective for the separation of oil from the large volumes of associated water effluent in the oil-fields. The process has been scaled up from 1 kg/batch to 100 kg/batch on the pilot scale. The de oiler produced in the laboratory has been tested successfully by ONGC(ER) Sibsagar, Oil India Ltd., Duliajan and also in this laboratory with effluent water samples collected from different oil fields of the north eastern region. The additive is found to be effective in removing as much as 90% of the oil present in the water effluent. So far, 3 tonnes of this deoiler have been produced in the pilot plant of RRL, Jorhat for field trials by ONGC (ER) and OIL, Duliajan.

A process for the manufacture of chrome lignite, a drilling mud additive has been transferred to M/s Balmer Lawrie & Co. Ltd., Calcutta; the firm has produced 6 MT of the material in its 1 TPD pilot plant and supplied the product to M/s OIL, Duliajan, for field trials.

The second aromatic extraction unit for extraction of pure aromatics using sulpholane as solvent based on the indigenous technology jointly developed by Indian Institute of Petroleum (IIP) and Engineers India Limited (EIL), has been commissioned in February 1989 at Cochin Refineries Ltd. (CRL). This unit is designed for a capacity of 187,000 TP A of benzene, 15,000 TPA of toluene and 46,200 TPA of low aromatic naphtha (raffinate), when run on full capacity. The purity of benzene produced is 99.99%. Costing over Rs.30 crore, the unit will save Rs. 100 crore in foreign exchange/

Lab scale know-how for making part-tert-butyl phenol, in 30 litres batch reactor, was transferred to Balmer Lawrie & Co. Ltd. The firm envisages to put up a commercial plant of 600 TPA capacity. The value of the product, when produced at full capacity will be Rs.3 crore.

Three runs, of 10 kg per batch finished pro- the desired purity level. About 11 kg purified duct, were successfully demonstrated to the sample, obtained from crude alkylates of de- representatives of the licencee. About 1.5 kg monstration runs, was sent to the licencee for crude sample from each run was further frac- consumer acceptance trials, tionated at reduced pressure and purified to

METALLURGY

A New Al-Zn-In Galvanic Anode for Cathodic Protection

A process for the preparation of a new Al-Zn-In galvanic anode for cathodic protection of structures submerged in sea water and in sea mud has been developed by CECRI. The use of Hg is totally avoided and the anode gives rise to efficient cathodic protection. High purity aluminium is not needed for this product as in the case of other aluminium alloy anodes.

Condition Survey of Bassein Creek Bridge, Bombay

CECRI has completed a consultancy assignment for the Chief Engineer, Bombay (PW) Region by visiting the bridge site and conducting on-the spot examination of the girders. The insitu examination consisted of visual observation, surface potential measurements, resistivity of concrete, cover thickness, resistance of the prestressed cables, wherever possible in some representative spans. On the basis of the data collected and analysis, a detailed report on the condition of the girders surveyed was given.

Recovery of Tin from Tin Sludge

NML has entered into an agreement with M/s Tinplate Co< of India Ltd, (TCIL) Jamshedpur for the transfer of technology for the extraction of tin from tin sludge generated during electrolytic tinplating (ETP) operation.

The process is based on roasting of the dried sludge, followed by smelting and refining operations and has the following striking features -

a minimum recovery of 90% tin contained in the sludge is guaranteed;

a minimum purity of 99.75% of recovered tin metal which can be recycled in ETP lines is achieved; and

a versatile capability of treating all intermediate tin products.

Implementation of this process will enable M/s TCIL to recover 4 tonnes of tin metal from the tin sludge with an annual saving of Rs. 10 lakh of foreign exchange. This will not only conserve otherwise wasted precious tin metal, but also reduce the pollution problem.

An Improved (Modular) Cell for Production of Mg Metal

The design and development by CECRI of an Improved (Modular) Cell for production of magnesium metal by electrolysis from seabittern and magnesite has been chosen for the NRDC Award. This modular concept of cell will save about 40% of electrical energy as compared to conventional cells.

Neodymium

Neodymium metal of high purity has been prepared by RRL (Trivandrum) by reduction of anhydrous Nd fluoride in 50 gram quantity per batch with an yield of 85-90% and good slag separation. Vacuum remelting of this metal yielded a product with a purity of 99.5%. An active programme is on for the supply of metal, for use in Nd-Fe-Boron Magnets as part of a collaborative programme with DMRL. Already 500 gms of rare metal has been prepared.

EDXRF

An EDXRF procedure was developed based on the chemisorptive preconcentration of trace amounts of rare earths and various analytical parameters have been evaluated for optimising the conditions for preconcentration. The precision and detection limit of the procedure is 5% and 20 ppb, respectively and represent a 100 fold enhancement in sensitivity limits.

Beneficiation

Bench scale beneficiation studies on representative sample of Magar Mohan mines of TISCO by gravity and flotation technique followed by magnetic separation indicated that the sample could be upgraded to yield two products assaying 54%Al2O3 and 58% AI9O3 respectively with low silica and iron. A 150 kg bulk concentrate of Grade II was pro diced and handed over to TISCO for being evaluated by different refractory groups of TISCO, IPITATA and TRL. A 25 kg concentrate is also being evaluated.

Iron

High purity iron powder low in oxide content has been prepared successfully by NML in a scale of 6 kg iron powder/day in a single cell using alternate anodes and cathodes. The process parameters for production of powder in sheet deposit have been optimised and characterisation of sheet deposit powder has been carried out. Samples have been sent to various user industries including Mahindra Sintered Products, Pune for evaluation. This is an NML-TATA STEEL collaborative project.

Fe-Cr

A 35 KW DC extended arc plasma reactor has been indigenously developed and put to operation by RRL, Bhu. During the year, ferrochromium has been prepared successfully by smelting chromite ore fines (50% C^Og) with non-coking coal fines as reductant in argon arc plasma. Degree of metallization of chromium and iron has been improved over 90% by optimising the process parameters like slag composition, duration of reduction, rate of flow of plasma forming gas etc.

Ferr-tungsten has also been prepared by carbothermic reduction of low grade wolframite ore fines (30% WOg) in the above plasma reactof. Work is in progress to optimise the process parameters.

Pelletisation

Based on the Memorandum of Understanding between RRL-Jorhat and RDCIS, SAIL, Ranchi, RRL-Jorhat has submitted the details of the cold bonded pelletization process developed at laboratory scale to RDCIS, SAIL for undertaking joint scale-up study being planned by SAIL at Gua Iron Ore Mines (100,000 ton/year capacity).

AGROTECHNOLOGIES

Improved Citral Yielding Indigenous Strain J or Lab CC2

An indigenous strain of wild Lemongrass *(Cymbopogon citratus)* was collected and acclimatised at RRL-Jorhat and later named as Jor Lab CC2. The oil recovery and the citral content percentage were around 0.8-0.9 (w/w) and 85.0-88.0 respectively. Similarly, the herb yield per hectare and oil were found to be around 30-35 tonnes and 240-315 kg respectively. The agrotechnology of the crop has already been worked out and it has now been grown in NE region of India by various growers.

Dioscorea in North East India

Dioscorea floribunda, which is one of the species of Central America and was successfully introduced and acclimatised in North East India particularly in Tripura has proved to be a source of diosgenin. The estimated annual requirement of diosgenin for the Indian pharmaceutical industries is around 2000 tonnes. Presently, only 500 tonnes of dioscorea tuber are produced in the country. The Tripura Forest and Plantation Corporation has taken up multiplication of *D. floribunda* with the planting material delivered by RRL, Jorhat. The rapid multiplication of *D. floribunda* organ culture by single node leaf cutting produced 80,000 plan tie ts having 40-60 gm tubers. With these plantlets a large area was covered under plantation.

Development of a High Yielding Variety of Mentha Citrata-Kiran

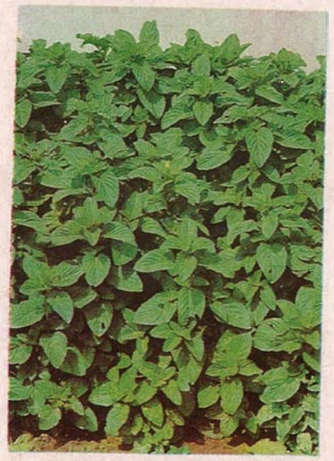
As a consequence of large-scale gamma-irradiation of suckers of locally grown strain followed by selection and repeated evaluation, a high oil yielding mutant genoty pe C1MAP/MCM-2, now-christened as variety Kiran, was developed.

Besides having distinctly superior oil yield, the newly developed variety has shown excellent regeneration capacity. Kiran has. great potential for increasing bergamot mint oil production per unit area and time so as to enable its growers to improve their economy.

Superior Variety of Lemongrass

Under the genetic upgradation programme of aromatic grasses at CIMAP, Lucknow, a genetically superior clone No.29 was developed through appropriate genetic manipulation. This clone, now christened as var. Praman registered its consistently superior performance for oil and citral yield over the now' available best variety Pragati of C. *flexsuosus* and RRL-16 (developed at RRL, Jammu) of C. *pendulus.*

Adoption of this variety under cultivation would substantially elevate the staggering production of lemongrass oil in the country and thus improve the export prospect to a great extent.



Mentha citrata variety: Kirari

Development of Geraniol-rich Variety of Lemongrass

CIMAP developed geraniol-rich lemongrass variety designated as GRL-1. This could be a potent substitute crop for palmarosa specially cultivated for producing citral, cultivation of GRL-1 is likely to boost the commercial cultivation of this crop as a rich source of geraniol in the country.

.Artemisia annua

An improved variety[7] of *Artemisia annua* named as ASHA was developed. This gave about 29 q/ha leaf dry matter. 0.11% artemisinin and 3.19 kg/ha artemisinin yield as compared with the original base population from Kew, England which produced only about 18 q/ha leaf dry matter containing 0.080% artemisinin and 1.45 kg/ha artemisinin yield. Under commercial cultivation it would enable us to produce the antimalarial drug at a cheaper rate.

Chrysanthemum

A gamma ray induced mutant of *Chrysanthemum* named 'Navneet' was released by NBRI as a new cultivar. A mutant of small decorative type chrysanthemum ev. "Kalyani Mauve" was also evolved. While the original colour of 'Kalyani Mauve' is pansy violet, the mutant has creamish white colour. Four commercially important cultivars of gladiolus, namely, 'Erovision', 'Friendship', 'Red Beauty' and 'Nichole' were established in culture through proliferation of dormant shoot buds, excised from mature corms. Induction of cormlets in tissue culture for virus-free plantlets has also been achieved in the cultivars, 'Friendship', 'Peter Pear' and 'Red Beauty'.

Tissue Culture of Economic Plants

A large number of *in vitro* raised plants of 3 bamboo species, namely, *Dendrocalamus strictus, Bambusa balcoona* and *Thyrsostachys oliveri* were successfully transferred to soil and grown under glasshouse conditions. Some plants of these bamboo species were also grown under field conditions in nomal soil as well as in substandard soil at Banthra Research Station.

Complete direct regeneration of disease free plants with well developed root system has been achieved by CSIR Complex, Palampur, from bulb scale segments of Easter and Tiger lilies. The regenerated plants are growing well in the field under outdoor conditions.

Pilot scale cultivation of two aromatic plant species viz. *Rosa damascena* and *Tagetes minuta* has been taken up by CSIR Complex Palampur. These species have shown good production potential for high value essential oils under existing agroclimatic conditions. Stem cuttings of Bulgarian genotype of *Rosa damascena* were procured from Haldighati, Rajasthan. The cuttings were raised in the nursery and twenty[7] five thousand plants have been transplanted in four hectares of land from July to September 1988. The plants have established well: those transplanted in July started flowering during the end of March, yielding 250 mJ of quality rose oil distilled from fresh flowers.

POST-HARVEST TECHNOLOGIES

A demonstration plant (250 kg/hr capacity') for the beneficiation of Sunflower seeds was set up by CFTRI. The process was released to 5 industries after due demonstration.

A method was standardized for the decortication of safflower seed with a dehulling efficiency of 85-90%.

Eight commercial estate clones have been released by TESTRA through field selection scheme in Assam and Tripura. Tea Board's approval has been obtained for their commercial use.

One Tockiai Seed Stock "TS 491" with the combination of SgAj and TV1 as parents has been released for commercial use.

Insect growth regulators Nomolt and Cascade and a synthetic chemical cartap hydrochloride were found to give effective control of bunch caterpillar under laboratory trials. Field trials will now be conducted by TESTRA to assess these products for commercial use.

The services of CSIR Complex Palampur have been retained by the Himachal Consultancy Organisation (HIMCON) and the Uttar Pradesh Industrial Consultants (UPICO) for preparation of tea development projects in Himachal and Uttar Pradesh respectively. The report on HP has resulted in the State Govt, sanctioning Rs.25 crore for a ten-year integrated tea development project in the State.

BIOTECHNOLOGY

Potential Chemotherapeutic Agent for AIDS

CFTRI has been interested in the preparation of bioactive compounds from indigenously available raw materials which would have applications in food and agriculture. Nojirimycin was originally isolated as a potential antibiotic from streptomyces. Deoxynojirimycin has recently been shown to be a potent inhibitor of glycosyllation (sugar adding mechanism) in a variety of systems including the assembly of the AIDS virus.

The CFTRI's process for the production of nojirimycin and deoxynojirimycin has the following advantages:

The synthetic method is simple, innovative and elegant and uses readily available raw materials.

It is highly cost effective

A variety of derivatives and analogs of nojirimycin and deoxynojirimycin can be prepared using this method.

The process offers high product yield and does not involve any costly equipment.

The process of CFTRI is being patented in India and abroad.

Centralized Facility for Distribution of Enzymes and Fine Chemicals

CFB has been recognized as the Centre for import and distribution of enzymes and fine chemicals to institutions and scientists engaged in advanced research in biotechnology in the country.

The value of enzymes and fine chemicals sold in 1988 was over Rs.45 lakh.

Microbial Enzyme for Unhairing of Hides and Skins

A proteolytic enzyme from a new fungal strain of aspergillus flavus has been prepared by CLRI using solid substrate fermentation. Detailed studies on the various parameters regulating the production of extracellular protease by this organism on wheat bran have been optimised. The enzyme was produced in the lab. at 500 gm. batch level in enamel trays. Further scaling up studies at 25 kg level were carried out at the fermentation technology and bioengineering division of CFTRI.

The greatest advantage in production and use of this enzyme is its low cost compared to that of similar enzymes produced and tried earlier. This is due to the simplicity of production by solid state fermentation which involves minimum number of operations. In fact initial calculation indicates the cost to be comparable with the chemical method of unhairing by lime and sodium sulphide which is highly polluting. Large scale trials of unhairing in commercial tanneries have been planned.

is expected to yield to our country a sunstantial amount in foreign exchange.

Fermentation

Chittoor Cooperative Sugar Distillery in the State sector has referred a problem concerning objectionable odours in the distilled spirits, and poor yiel'ds of alcohol, which has resulted in the shutting down of the factory for over three months. The team of scientists from RRL (Trivandrum) has streamlined the fermentation process after carrying out detailed chemical and microbiological analysis. A detailed protocol for start up of the process was given, which on implementation has enhanced the yield,, besides producing a product of good quality.

Studies on the effect of oxygen partial pressure and cyclic changes of dissolved oxygen in airlift loop reactors have been carried out by RRL, Jammu under CSIR-KFA(FRG) collaborative project on "fermenter design and pressure fermentations". The positive effects on fungal based fermentation processes are being covered by patents in FRG and India.



Clearance zones of Xylan agar plates due to Xylanase secreted by Chainia colonies

Development of a Cellulase-free Xylanase Enzyme

NCL has succeeded in isolating from the desert sands of Rajasthan a unique strain of the organism called CHAINIA belonging to the actinomycetes family. This strain secretes a low molecular weight enzyme, Xylanase, capable of selectively degrading hemicellulose (Xylan). Since Xylan reduces paper pulp quality, this discovery is hailed as a breakthrough for the paper industry. The NCL enzyme has been produced by Finnsugar Co. Ltd., Helsinki for joint evaluation by NCL, the Iowa State University, USA and the International Paper Company, USA. The success of this joint venture

COAL AND MINING

Non-Coal Mine Workings

The room and pillar stope design with caving proposed by CMRS for Maldeota mines (Himalayas) was successfully adopted for the extraction of a 3 to 3.5 m thick phosphorite ore body. For the steeper and wider ore body at Dhurmala mines, a shrinkage stope method designed by CMRS was successfully adopted with improved productivity.

At Amjhore mine, the workings were designed for increasing the production from 150 to 700 TPD. Mine mechanisation was proposed and the method of working was modified to meet the increased target of production.

The underground manganese mines at Balaghat, Chickla and Kandri experienced difficult ground conditions due to the weak nature of stope walls and highly jointed ore body. After extensive geotechnical studies CMRS suggested reduction of the span of working and a pillar stope method of working was recommended. The design parameters were also suggested. As a result, the ground conditions were improved.

Utilisation of Waste

West Bengal Small Industries Corporation is going to set up a fly ash brick plant at Bandel with a capacity 60,000 bricks per day using fly ash from Bandel thermal power station. Another firm M/s Janapriya Developers Ltd. is going to set up a fly ash brick plant with a capacity of 30,000 bricks per day at Sodepur near Calcutta. These plants are based on CFRI know-how for production of bricks from fly ash.

Mine s-Metals-Habitat Programme (MMAHA)

RRL(Bhu) is implementing an integrated programme for all round development of mines and surrounding areas, by adopting proven technologies. Two projects - one for the Orissa Mining Corporation (OMC) at the South Kaliapani Chromite Mines, Cuttack and the other for the Uttar Pradesh State Mineral Development Corporation (UPSMDC) at Lambidhar Limestone Mines near Mussoorie have been completed.

Mine Safety and Subsidence

It was predicted by CMRS from studies at East Katras colliery, where gallery blasting method of extraction was being experimented, that the main fall would take place after the total area of extraction of 4457 m^2 while the actual fall area was 4225 m^2. A higher rate of convergence was also observed 3 to 4 days prior to roof fall. The prediction of CMRS on main falls had helped the mine management to withdraw the workers in time from the face.

Subsidence investigation was completed over 12 panels and is in progress over 87 panels/ workings in different coalfields of India. On the basis of this investigation, safe limit of strain and maximum operating gradient for jointed rail construction, maximum permissible strain in the bed of water bodies, maximum elongation or compression for buildings, maximum permissible strain and displacement for high tension pylons and aerial ropeways, maximum permissible change in gradient for roads, etc., were recommended by CMRS. Experiments were also conducted for the development of a three dimensional equivalent material modelling technique to study the subsidence due to mining.

Coal Processing

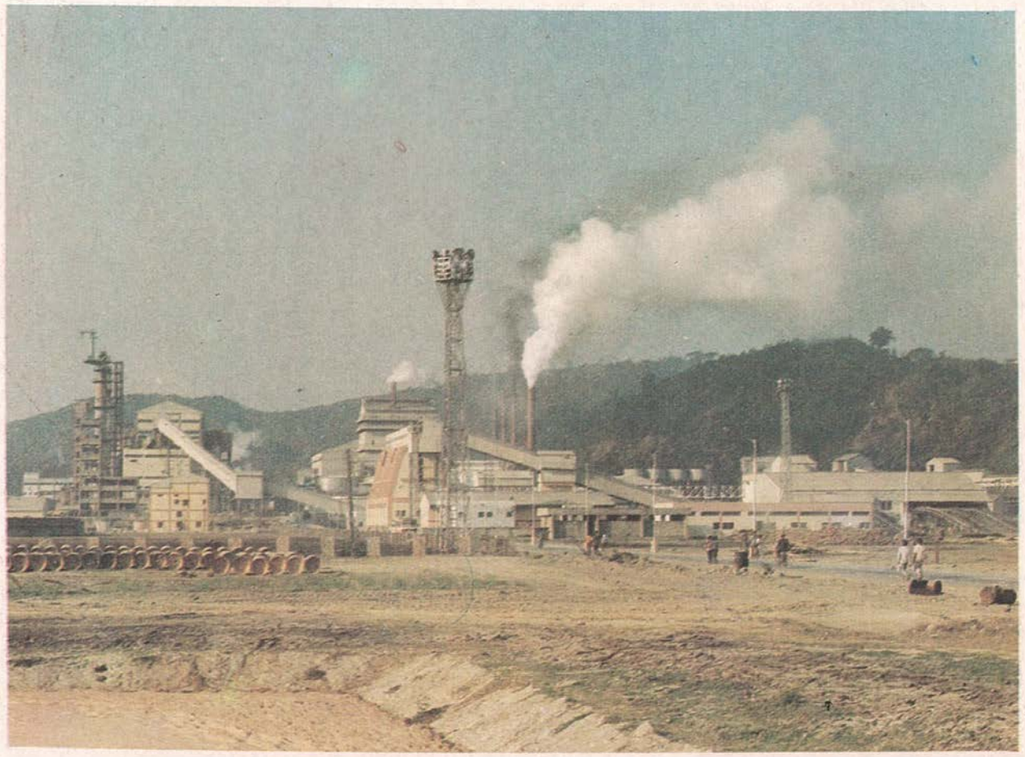
Under a collaborative programme of work with various exploration agencies like (JSI, CMPDI, MEC, CIL and various State Departments, etc., CFRI has processed 19,500 m length of borehole core and analysed 35,700 samples (coal and lignite).

ECOLOGY AND ENVIRONMENT

Hazard Study and Risk analysis of the Gas Processing Complex of ONGC, Hazira were carried out and recommendations on safety of plant, personnel, and emergency preparedness plans were given. Training was also provided to ONGC personnel on Hazard Study and Risk Analysis methods and Techniques. The assignment was carried out by CLRI, IICT, RRL, Jorhat, ITRC and NEERI, in collaboration with the Industrial Safety Department of TNO, Netherlands.

NEERI concluded a sponsored study on Rapid BOD test (3 days, 27°C) to replace the Standard BOD test (5 days, 20°C) through an extensive and coordinated research on various pure substrates and real-life water and wastewater samples. This advancement is considered a major breakthrough in view of the appropriateness and cost-effectiveness of the proposed test in tropical countries. The conclusion to replace internationally accepted Standard BOD test with the rapid test has been verified through rigorous statistical analysis.

Application of water spray to reduce the dust concentration in the air of Khetri copper mines as well as use of personal protective equipment were recommended by CMRS on the basis of assessment of dust concentration at the mine. Dust survey was also carried out by CMRS at nine coal and two iron ore mines to recommend suitable measures for controlling the respirable dust. Physical parameters of dust produced during various mining operations were studied at CMRS to find out a correlation between them and their impact on health and air pollution problems.



Environmental Impact Assessment at HPC Units in Assam

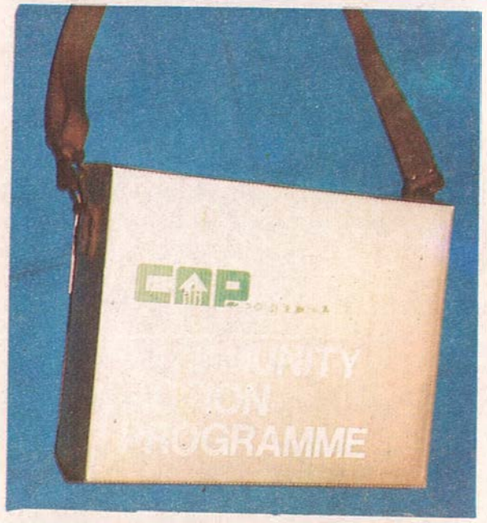
Environmental Impact and Risk Assessment :

NEERI carried out rapid and comprehensive environmental impact assessment studies for following projects :

- Gandhar oilfields, ONGC
- ONGC's offshore facilities at Uran
- Mangalore refinery & petrochemicals limited
- HPC paper mills at Nagaon and Cachar

In addition, NEERI contributed to hazard and risk assessment study undertaken by CSIR for Hazira Gas Processing Complex of ONGC by collecting interfailure statistics of various equipment to enable estimation of reliabilities of various vulnerable pathways in the process flowsheet. The study employed Markov models to delineate positive impact of preventive maintenance measures on system reliability. It also suggested risk abatement measures for substantial improvement in system reliability.

NEERI has developed a *CAP (Community Action Programme) kit* for insect and rodent control under the joint sponsorship of the World Health Organization (WHO) and the United Nations Environment Programme (UNEP). This is an information package delineating preventive environmental measures which the residents could undertake to protect themselves from vector proliferation. The kit is envisaged to be used as a part of Governmental/non-Govemmental health programmes.



CAP Kit for Insect and Rodent Control



Three Compartments in CAP Kit

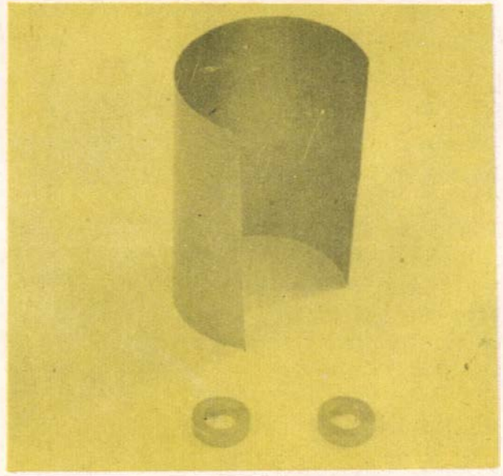
MATERIALS

Flexible Graphite Foil

NPL has developed flexible graphite foil using totally indigenous raw materials. The basic process consists of intercalating natural graphite and exfoiliating it to the extent of about 400 times in the c-direction, followed by pressing, etc. Some of the physical characteristics of the foil developed by NPL are

Coefficient of Thermal Expansion between (50-1000° C)

(a) Along c-direction	15-20x10^{6}/°C
(b) Along a-direction	Nil
Tensile Strength	65 kg/cm^
Breaking Strain	1.5-2%
Bulk Density	1-1.5 gm/cc
Compressibility at 350 kg/cm^2	30%



Flexible graphite foil

This material offers outstanding resistance to corrosion at elevated temperatures and can retain compressibility at all temperatures. In addition, it is resistant to radiation doses of any magnitude occurring in nuclear power stations. Consequently, it is an excellent material in gasket applications in refineries, fertilizer plants, nuclear plants, thermal power plants, automobiles, etc. Besides, flexible graphite foil has been found to be an excellent substitute for asbestos which has been shown to be carcinogenic.

Carbon Fibre Rudder

A carbon fibre rudder for Dornier 228 aircraft jointly developed by NAL and DFVLR has successfully passed all ground tests.

Installation of Optical Fibre Audio-Communication (Telephone) System in Coal Mines

CGCRI, in collaboration with CMRS and CSIO, has successfully installed an optical fibre communication system using 225 metres of Duplex optical fibre cable for a surface to underground audio-transmission link (telephone) in Malkera Colliery (TISCO), situated about 30 km. away from Dhanbad (Bihar). This is the first time in this country that such a system has been installed and made operational in the hazardous environment of a coal mine. The standard low-loss optic fibre-multimode graded index variety having 50 *pm* core/125 gm clad - has been indigenously developed at CGCRI for the first time from precursor glass (preform), the technology of production for which was also developed at CGCRI. The fibres were coated with acrylate resin and then jacketed with jelly filling. The jacketed fibres were cabled by the Hindustan Cables Ltd. Because of the immunity of the waveguide to electromagnetic interference, the optical system does not suffer from noise, unlike the conventional metal conductor cable system.

Space Qualified Multicavity Interference Filters

Development by NPL of Space Qualified Multicavity Interference Filters for the infrared band

of smart sensor (payload of Rohini Satelhte-D2) has been selected for NRDC Award. These filters provide a large bandwidth and low background transmission, showing steep rise and fall with nearly flat top transmission characteristics. These filters are prepared by having a great degree of control over various deposition parameters and using a novel sequence of depositing constituent layers of coatings.

Composites

As part of a long-term programme on composite materials, NAL has developed a high strength high-modulus synthetic fibre (to which the name NALAR has been given) spun from a wholly aromatic polyamide. These fibres have a tensile strength (yarn) of over 2.7 GPa and a modulus ranging from 80 to 120 GPa. They have high thermal stability and good retention of mechanical properties upto about 2000°C. The creep resistance of these fibres is very good both at ambient and at elevated temperature upto 2000°C). This combination of properties makes them attractice not only for aerospace application but also as reinforcing fibres in rubber, thermosetting resins and thermoplastics.

An NLF aerofoil of 17% thickness ratio was designed. This aerofoil, designated as NAL-NLF-170, is expected to have better lift drag values in the operating C_L range compared to a known [GAW (1)] aerofoil of similar thickness. Aerofoils also have been designed for natural laminar flow for application to NAL's trainer aircraft and to a transport aircraft proposed to be designed at NAL.

Glass and Ceramics

CGCRI has built up expertise in the use of sol-gel processing technique in the area of glass and ceramics. The sol-gel route has been successfully employed in producing anti-reflective coatings' on radiation shielding window (RSW) glass blocks as well as for a novel, near-neutral optical coating on glass for anti-glare applications. Two patent applications have been filed in respect of the latter coating which cuts off U.V. wavelengths substantially and, in two-layer design, cuts off gamma.

BUILDING MATERIALS AND CONSTRUCTION

Energy Efficient Gypsum Calcinator

As against 300 kg of coal normally consumed in calcining 1 tonne of gypsum in Open Pan System mostly used in the country, the new calcinator developed at CBRI consumes only about 60 kg of coal - thus achieving over 80 per cent saving in fuel. In addition, the calcinator saves about 10 per cent of gypsum which in open pans is lost as dust (causing environmental pollution and material loss). Power churning and effective monitoring of the temperature of the charge in the calcinator ensure quality of the plaster. Concentration of pollutants in chimney stack is much below the allowed limits prescribed by the Central Board of Prevention & Control of Water/Air Pollution.

Based on CBRI know-how, a 10 TPD calcinator for Cementitious Industry, Siltiguri (WB) and a 5 TPD calcinator for M/s R az Chemical Works, Baramulla (J&K), are in commercial production. Two calcinators, each of 5 TPD, are under installation by M/s Prince Chemical Industry, Nanglapuram (TN) and M/s Jindal Chemical Enterprises, Kamrup (Assam).

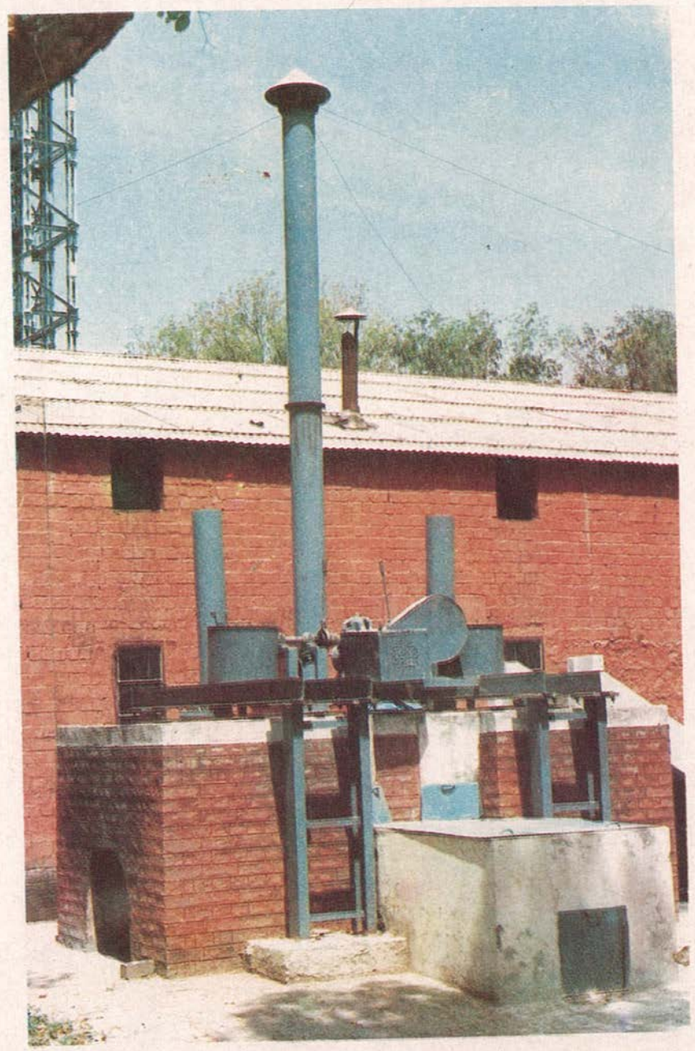
CBRI bagged the Republic Day Award-1989 of NRDC for this innovative project.

Ceramic tiles

A modified process for making unglazcd ceramic tiles from pyrophyllite mineral has been developed by RRL(Bhopal). The process makes use of an easy-to-grind raw material as

compared to relatively hard constituents - feldspar and quartz used in the conventional process. The number of steps has been substantially reduced and the temperature of firing has been considerably lowered. This has resulted in enormous saving in fuel consumption.

The productivity in this process is higher due to the higher green and fired strength of the tiles. The tiles made by this process possess impact strength of 0.027-0.032 kg/cm‘1 and water absorption of 10%. The process is available for commercial exploitation.



Energy Efficient Gypsum Calcinator

STRUCTURES

The Department of Atomic Energy (DAE) requested SERC-G to undertake the instrumentation of Narora Atomic Power Project Containment Vessel-1 and assess its structural behaviour during pressure test.

SERC-G accepted it as a sponsored project with the following aims and objectives:

Planning of instrumentation for strain and deflection measurements;

Measurement of radial displacement of the containment at four azimuths, at five different elevations and vertical deflections at four points at EL 117.60:

Measurement of vertical movement of containment slab at several points: Junction of ICW and base raft, Near the largest opening and Junction of ICW and containment slab.

Measurement of surface temperature at a few points near to the gauge locations;

Preparation of Test Report.

The final test was completed in November 1987 and a project report giving recommendations/conclusions submitted to DAE in June 1988. The recommendations/conclusions have been accepted.

In the area of steel structures, tower panels with different bracing (k and x) systems were taken up by SERC(M) for analytical and experimental studies. A mathematical formulation for the non-linear and failure load analysis of towers taking into account both geometric and material non-linearities was completed. A computer software package has been developed using the above formulation, with an interactive pre and post-processor. The design capability of the program conforms to I.S. Code provisions.

Strong rooms and underground vaults in banks are required to resist blast and impact loads, besides penetration by intruders who may use sophisticated tools and devices. At the instance of the Reserve Bank of India (RBI), Madras, SERC(M) successfully carried out a project on the ’"Use of fibre reinforced concrete in strong room”. Investigations were aimed at studying the properties of fibre reinforced concrete to resist impact type of loading and also its potential to arrest spalling of concrete caused by hammering or drilling or flame heating. Based on these investigations, recommendations were given for concrete with combination of steel fibres in addition to the conventional reinforcing bars, and specially fabricated tang bars.

At the request of the Research and Development Estt. (Engineers), Ministry of Defence, Pune, SERC(M) has successfully carried out theoretical analysis and experimental investigations of a Launcher structure for Project AGNI.

The launcher structure is a steel lattice tower which can swing from horizontal to the vertical position about the hinges at its base. Analysis was carried out both for static and dynamic loading conditions, and also for its resistance to the lift-off loading. The experimental investigation included measurement of structural response of the launcher tower during the proof test and also measurement of deflection and natural frequency of the tower under excitation.

TRANSPORTATION

Hill Roads (Road Alignment in Landslide-Prone Terrain in Sikkim)

North Sikkim Highway traverses terrain which is susceptible to recurrent landslides. The locations at Rang-Rang Lantak Khola are two sites where landslides have been persisting for nearly two decades. On an assignment from the Border Roads Organisation, CRRI studied the area comprehensively, leading to a pioneering approach towards deciding on the alignment, based on the hazard zonation concept which in turn involves evaluation of potential slope stability based on geological, geohydrological and geotechnical factors, with weightage given to vegetative cpver, sub-surface conditions, drainage and flow patterns. Based on the study, it was found that a new alignment would provide a better solution than correcting the hill slopes on the existing alignment. The new highway section has recently been constructed as per the recommended alignment resulting in a better level of service.

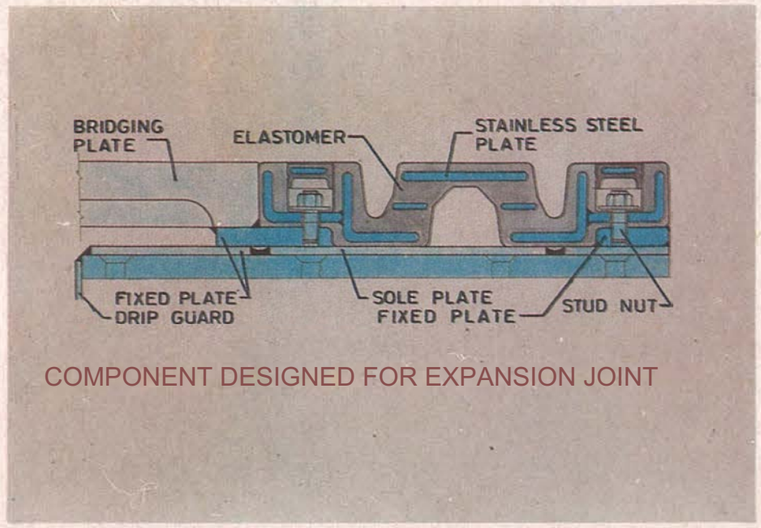
Rehabilitation of Bridges (Restoration of Articulation and Expansion Joints)

The Rabindra Sethu (Howrah Bridge) in Calcutta, the longest steel cantilever bridge in the world, has two main expansion joints and four articulation joints. After having been in long service for about 45 years, these joints had developed serious distress. The task of restoring them was assigned to CRRI by the Calcutta Port Trust. After careful study of the rotational and other movements involved, the Institute prepared cost-effective designs based on removal of existing components and substitution with the replaceable components of new design. The Calcutta Port Trust has taken up implementation of the CRRI design which substitutes for imported components.

Road Safety

CRRI took up in-depth studies with an imported computerised Act-React System involving a large number of drivers drawn from the Delhi Transport Corporation and other Public Sector Undertakings. As a result of these studies, two new sub-systems have been developed. The first unit, developed jointly with CSIO, Chandigarh, is for testing largely the physiological aspects and is aimed at use by the Driver Licensing Authorities. This is being commercialised in co-operation with NRDC. The microprocessor based equipment is very useful for the study and correction of accident-prone drivers and for selecting drivers for important duties.

If concrete pavements can be repaired quickly, the traffic operations are not hindered and propagation of damage can also be checked. Repair with resins is one solution but is expensive. CRRI has developed a rapid setting material based on magnesium phosphate. The formulation was arrived at after experimentation with different components and study through X-Ray diffraction and infra-red spectroscopy. The mortar has good strength and durability and has be^n tried on a few typical panels requiring repair. Work is at hand for modifications so that the pot life could be increased without sacrificing strength.



COMPONENT DESIGNED FOR EXPANSION JOINT

Air Transport

In connection with the development of air-transport in the country, CRRI completed a project of national priority on the request of the National Airport Authority to evaluate the structural and functional levels of about twenty airports for identifying the needed measures for improvement. The work included the study of sub-surface conditions through coring and test pits. The structural evaluation was done through the reverse design approach. The recommendations have since been taken up for implementation by the National Airport Authority in a major effort to expand the airfield network for the operation of modern aircraft.

COMPUTER SOFTWARE

Oil Pipeline flow Simulation

A computer software was developed by RRL, Jorhat in collaboration with CLRI, for simulation of Flow type and Pressure drop in a network of oil pipelines. Using this software the oil pipeline operating data of past years of Bombay High was analysed, important conclusions were drawn and recommendations given for controlling the factors of increasing throughput of the line.

Development of Computer Software (SACS) for Alignment of Propulsion Shafts in Ships and Submarines

SACS is a computer aid to marine engineers for designing and maintaining proper alignment of propulsion shafts of marine vessels such as ships and submarines.

The software carries out analysis of the shaft for any static or dynamic load; gives the engineer all the useful information on free or forced vibration effects, checks the clearance in the stern tube and recommends slope-boring, if necessary; helps by providing information for controlling the behaviour of the shaft, to the extent possible, by offsetting the bearings up or down, and computer optimal bearing-offsets to achieve a target set of reactions at the bearings within the specified constraints.

This software is being extensively used by the Directorate of Naval Design, New Delhi, for design calculations on propulsion shafting of new ships/submarines and by naval dockyards at Bombay and Visakhapatnam, for realignment of shafting during rep airs/refits of naval ships and submarines. Design check for a 650 ton oil tanker under construction at Goa Shipyard Limited, Goa, has also been done with SACS.

A fast response menu-driven data base management system (DBMS) for managing and analyzing the huge amount of wind tunnel data

on aircraft configurations has been developed by NAL and made operational on Data Acquisition, Processing and Interactive Control System (DAPICS). The first version of DBMS, operational now, is restricted to tailless configurations.

C-MMACS

The CSIR Centre for Mathematical Modelling and Computer Simulation (C-MMACS) was formally inaugurated by Dr. A.P. Mitra, Director General, in March 1988. The creation of C-MMACS was in recognition of the important role that mathematical modelling and computer simulation have now come to play in the development of science and technology, and the increasingly larger resources being devoted to research in the subject. The objectives of the Centre are the following.

To develop expertise and facilities and to nurture excellence for tackling major mathematical modelling and simulation problems (including new software development) and to take up related research in identified areas primarily of relevance to CSIR, within the Centre and in collaboration with other CSIR Laboratories.

To promote mathematical modelling and computer simulation across the spectrum of activities of CSIR Laboratories by all available means including organisation of workships, training programmes, seminars, brainstorming sessions, etc.

To strengthen existing units in CSIR Laboratories and Headquarters working on mathematical modelling and allied activities and to coordinate their work.

The current research activities of the Centre include modelling of sedimentary basins, modelling of metallurgical processes, and modelling of climate. Several new joint projects with CSIR laboratories are planned for 1989.

GAD

Computer Aided Design facility at CLRI has been functioning for the last two years and has been able to attract a number of customers from the industry. Consultancy was undertaken from 8 firms for generation of various styles including safety shoes for gents, Moccasin, sports shoes, slip-on shoes for gents and children^ fashion shoes. A contract has been signed with an Agra-based firm for generation of 50 new footwear designs. Five designs have already been completed and handed over to the customer. At the request of M/s Bata India Limited, CLRI scientists organised a one day seminar at Calcutta to popularise CAD facility. Similarly a Footwear Industry - CLRI Get-Together was organised for popularization of CAD facility and the footwear pilot plant facility. This was attended by representatives from more than 30 industries from all over India.

Software for automated retrieval of earthquake data were implemented by RRL, Jorhat. This enabled segregation of data for specified magnitude, depth, period and zone of interest from NOAA as well as RRL, Jorhat process data. This was integrated with the software for preparation of epicentral maps, depth sections, space-time distribution, b-value and hypocentral trend surface analyses (HTS). A detailed study of- the pre and post-conditions of the earthquake on 6th August 1988 were completed.

Data Base on Water Quality in Gurgaon

Under the Technology Mission on Drinking Water, a sectoral database on water quality was developed for Gurgaon district and an interim report on **Quality of Drinking Water in Sohna Block, Gurgaon District (Haryana)" was also brought out by NISTADS. Computerized Thematic Maps indicating village boundaries have been produced for the development departments.

BASIC RESEARCH

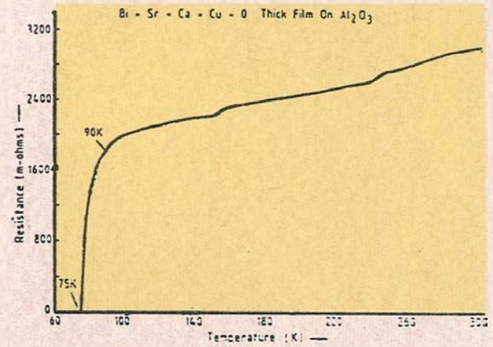
High Temperature Superconductivity

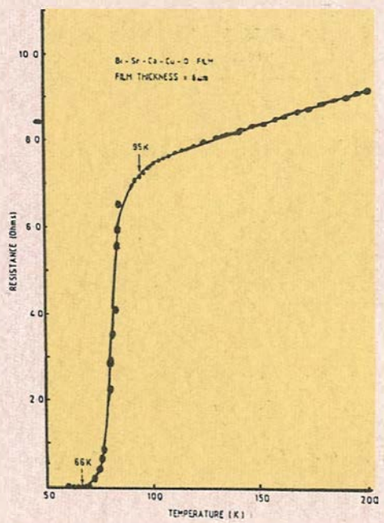
Basic research on high temperature superconductors at NPL has continued with studies of single phase samples of Bi-based compound having a stable Tc (R=0) of 9IK- as compared to the generally reported value of 85K. Y-based 1-2-3 compounds have also been synthesized and show Tc (R=0) of 108K instead of the usual value of 90-94K. However, Tc of 108K is found to be unstable with respect to thermal cycling and the stable Tc is found to be 93K. Substitutes of Pb,Ga,Zn, Fe, Co and Ni have been carried out in'the Bi-based system. Fe has the largest effect in depressing Tc and the effect is more pronounced than in the Y-based 1-2-3 system. The behaviour is understood in terms of the characteristic crystal structures of two systems and the .occupancy sites of Fe. Possible confirmation of Fe occupancy at the Cu-sites is obtained from the preliminary Mossbauer studies carried out in collaboration with the University of Udaipur. Zn substitution in Bi-based system does not however produce so pronounced an effect on Tc as found in Y- and La based system studied extensively at NPL earlier. The results are understood in terms of Zn possibly occupying non-Cu sites. Indications of extra high Tc above 200K are also noted. The problem of Zn substitution in all the three systems is currently being looked at in depth using XANES in collaboration with the University of Rajasthan.

High Temperature Superconductors for Micro Electronics

A new system based on Bismuth cup erate oxide superconductor (Bi:Sr:Ca:Cu:O) was discovered (by the Japanese) in 1988. It apparently has important advantages over the 1,2,3 compound, such as resistance to humidity, low sensitivity to oxygen defects, and low processing temperature, which are very important from the point of view of application of high Tc superconductors to micro-electronics devices.

CEERI achieved Tczero =85K in Bi:Sr-.Ca; Cu:0 systems. In fluorine implanted Bi.Sr.-Ca: Cu:0 system, Tczero = 90K was observed for the first time. Thick film (50 gm) of Bismuth system on .Alumina substtrate resulted in Tczero = 75K with onset at 90K.





Josephson tunneling was observed at and above liquid nitrogen temperature in a constricted fluorinated sample of bismuth cuperate. The temperature dependence of the critical superconducting current of the weak link was found to be of the form $I_Q (1-T/Tc)^6$ which depicts typical bridge-type characteristics.

CEERI has developed spin-on technique to fabricate superconducting film of high Tc material. Films of Bismuth cuperate (thickness 6 pirn) on alumina exhibited Tc (0) = 66K and Tc (on) = 95K.

Lead substitution in bismuth oxide superconductor resulted in Tc enhancement in the bulk sample; CEERI achieved Tc (0) = 113K and the system appears to carry high current density compared to unleaded samples.

Photolithography and laser ablation techniques have been used to obtain micro-patterns in high Tc materials films. Micro.bridges have been fabricated in the superconducting films to study Josephson effects.

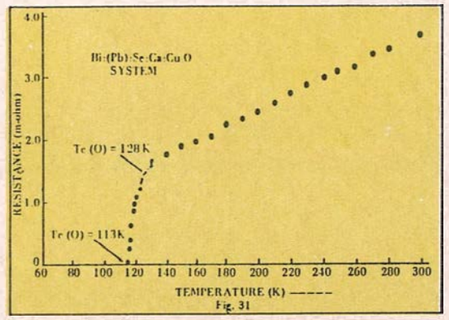


Fig. 31

High Tc Superconductor wires and foils

The feasibility of fabricating the 1-2-3 superconductor wires and tapes by electrophoretic deposition of the superconductor powders on silver wires and foils was successfully demonstrated at CGCRI. The method is much simpler than the other techniques commonly employed in this respect. The cross-sectional configuration of the wires produced by this technique was different from that obtained by the wire drawing technique. The wires remained flexible even after sintering. Electrical resistivity and susceptibility measurements indicated the Tc of the fabricated wires to be around 90K. A patent application has been filed in respect of this process.

Geophysics

Monitoring of local seismic activity through the network 'levels' the large number of earthquakes occurring in the region. The seismicity map showed distinct zones characterized by different levels of seismicity. Comparison by RRL, Jorhat of the records since 1985 through 1988 showed continued improvement in recording capability. The Mikir block experienced a few significant earthquakes occurring around NNW-SSE Kipili lineament thereby indicating seismic activity connected with the lineament.

In' the Indo-Burman orogenic belt shallow and intermediate depth earthquakes frequently occurred with different levels of seismic activity within the zone itself. The Naga Hill segment showed predominantly crustal activity with little uppermantle seismic events, whereas the Chin Hill segment was unique, showing intense activity of shallow and intermediate depth earthquakes. Further south with the approach of the Arakan-Yoma segment the intermediate events were rare and show simultaneous decrease of shallow earthquakes.

The results of the investigation showed that the present seismic activity was not distributed randomly, being bound either to the Indo-Burman Wadati-Benioff zone or to clearly defined fracture zones. These fracture zones form a relatively complicated tectonic pattern, which however, reflects the present stage of the stress field produced by the continental collision in the convergent boundary region between the Indian and Eurasian plates. One half of 566 earthquakes, considered in this study, was bound to the fracture zones and one half to the Wadati-Benioff . zone. This ratio was higher than that usually observed in convergent plate margins with active subduction.

Catalysis by Zeolites

Isomorphous substitution of iron in the framework of various zeolites such as ZSM-23, EU-1, BETA, Mordenite and faujasite:

As ions like B^{+}, Fe^{+}, Ga^{+} possess values of charge/ratios different form Al^{+}, the intrinsic acid strength of their associated protons and, hence, their catalytic activity and selectivity in acid catalyzed reactions will vary when Al^{+} in zeolites is substituted with these ions. Iron analogs of various medium and large pore zeolites such as ZSM-23, EU-1, Mordenite, Beta and gamma, have .been synthesized by NCL and characterized by different techniques. The evaluation of catalytic activity and selectivity of these iron containing zeolites has been carried out using meta xylene isomerization, a well known test reaction having both scientific as well as industrial importance.

Synthesis, characterization and catalytic evaluation of titanosilicates, aluminotitanosilicates andferrititanosilicates:

The potential of zeolites in the selective preparation of various fine organic chemicals is now increasingly being exploited, particularly in the selective preparation of oxygenated components. For this requirement, titanium and zirconium have been isomorphosuly incorporated in the lattice position of ZSM-5 and ZSM-11 zeolite structures. The presence of titanium in the zeolite framework has been evidenced by the lattice expansion of the zeolite calculated by XRD, IR and adsorption of normal and cyclohexanes. The titano silicate, titanoaluminosilicate and titanoferrisilicate have been found to be highly selective for the preparation of catechol hydroquinone from phenol and hydrogen peroxide.

Superabsorbing polymers

Superabsorbent polymers are polyelectrolyte in nature and have the ability to absorb enormous amount of water in the range of 100-1000 g/g of polymer. These polymers have potential applications in agriculture, medicine, separation processes, industrial thickeners and controlled release technology. An understanding of transport processes in these polymers is important from fundamental and technological view points. Studies were undertaken by NCL to elucidate the role of various structural attributes governing the phenomenon of superabsorption and explore some novel applications of these polymers. Extensive NMR investigations have been carried out to understand the state of water in these highly swollen superabsorbent polymers. Some new findings on deformation dependent superabsorption, new phase transitions, recurrent phenomena, and unusual memory effects have been discovered.

Cellular and Molecular Biology (CCMB)

Seminalplasmin

Seminalplasmin has been shown to inhibit the binding of anti-CD-4 antibodies to the surface of CD-4 antigen carrying T lymphocytes. As the CD-4 antigen on the surface of T helper cells acts as a receptor for the AIDS virus, these observations strongly suggest the possible use of seminalplasmin as an anti-AIDS agent.

Seminalplasmin has also been shown to lyse dividing cells but not resting cells; it could thus be used as a marker to distinguish between resting (G_o) cells from the cells which are in the cell cycle.

Ribonuclease and RNA turnover

Mammalian liver is known to possess several ribonuclease (RNase) activities. One such RNase, namely RNase II, is distributed in various subcellular fractions and may be present in an inactive or latent form or as an active enzyme. RNase II in the liver cytosol is present virtually entirely in the latent form complexed with a protein inhibitor. The activation of this inhibitor bound enzyme is considered to play a key role in cell metabolism. To understand the mechanism of this process, experimental conditions which result in cellular activation of this enzyme have been worked out; isolated rat-liver parenchymal cells and liver tissue after partial hepatectomy possess RNase activity at levels consistent with cellular activation of the latent enzyme. The enzyme from isolated liver cells has been purified, characterised and identified as the one involved in the RNase-inhibitor system in liv liver; the activity in the soluble protein extracts from the liver tissue following partial hepatectomy also appears to be an analogous activity.

Mechanism of cataract formation

A very common affliction of the eye is the formation of a cataract. When cataract forms, the eye lens is no longer transparent but becomes opaque, leading to sight deficiency. A new method has now been derived for studying the changes that happen to the intact eye lens during cataract formation directly, using fluorescence properties of the protein that constitute the lens. Cataract is generated in the eye lens by shining ultraviolet light or by other chemical methods. An important finding has been that there exist clearing mechanisms in the lens that lead to the reduction or total avoidance of the damage (for example, by ultraviolet light) that leads to cataract. In cataractuous lens, such clearance mechanisms become inoperative.

Mechanism of heat shock

All living organisms respond to environmental stress, including heat, by synthesizing a set of new proteins. It has been shown during the year that proteins which are constitutively expressed in the adult, are induced in the embryonic tissues by heat shock. Specifically, albumin, a major adult liver - specific protein was found to be induced by giving heat shock to the embryonic cells. At the same time, the synthesis of alfafetoprotein, which is present in embryonic cells and the synthesis of which stops when albumin appears, ceases upon the premature appearance of albumin. This suggests that the developmental controls that reciprocally regulate the synthesis of alfafetoprotein and albumin operate at an early stage on giving heat shock to embryonic cells.

The internal pH of the embryonic liver cells increased by 0.2 pH units when cells were given heat shock. Chemicals that induce a change in the internal pH of the cells, induced the synthesis of albumin at normal temperature. These results suggest that the synthesis of albumin in embryonic cells is, probably, due to a change in the intracellular pH caused by heat shock.

Chromosome separation

A technique has been established for making chromosome suspensions from tumour cells for carrying out flow sorting of the marker chromosome from the tumour cells.

Mathematical modelling of biochemical reactions

A realistic model for the tryptophan operon in bacteria was studied and feasible conditions (i.e., mutations) for over-producing this amino acid were obtained. Tryptophan being an essential amino acid, this study may help in its biotechnological production.

A model for general metabolic network involving common biochemical mechanisms such as end-product inhibition and enzyme activation, showed a variety of behaviour - stable, periodic and chaotic. This shows that even simple biochemical systems can enter or exist in a chaotic state under certain conditions. This would explain the aperiodic or random behaviour observed in many cellular functions under both normal and pathological conditions.

Drug research

A proaggregatory unreported protein factor has been found in thromboembolic mice plasma. It acts in a calcium dependent manner synergistically with known platelet agonists.

Cholinergic and opioidergic mechanisms have been found to be involved in stimulus produced analgesia from pretectal region.

Chloroquine entrapped in anti-mouse erythrocyte F(ab.)2 bearing liposomes has been found to effectively control the chloroquine-resistant *Plasmodium berghei* infection in mice. Tuftsin bearing liposomes have been found to be useful not only as vehicle for drug targeting in *Leishmania donovani* infection but also in enhancing the non-specific resistance of animals against this infection (CDRI).

Biotransformation of unnatural 1-benzyltetrahydroisoquinolines to unnatural aporphine and tetrahydroprotoberberine alkaloids in living plant has been demonstrated, suggesting that many enzymes in higher plants are non-specific and are able to catalyse the biosynthesis of 'unnatural alkaloids' from 'unnatural precursors'.

Microbial Technology

A monoclonal antibody was raised against Tissue Plasminogen Activator (t-PA). This Monoclonal antibody is to be used for affinity column chromatography as well as for screening cDN A library in *E. coli.* Besides this, the work on cloning of gene for t-PA was started.

It was established that p-aminosalicylic acid, coupled to maleylated bovine serum albumin (MBSA) could kill macrophages infected with *Mycobacterium tuberculosis* in an in vitro model of tuberculosis.

Adenosine kinase, a key enzyme of the purine salvage pathway, has been purified to homogeneity and kinetically characterized by IICB. For the evaluation of antileishmanial potency of carriercoupled drugs, both macrophage culture model (in vitro) and animal model (in vivo) of leishmaniasis have been developed.

An engineered *E. coli* strain transformed with plasmids containing cloned cholera toxin gen was found to synthesize toxin proteins that were also excreted. However the strain failed to colonize in the intestine. Adherence experiments are now under way.

Enzyme immunoassays, diagnostics, tissue-targeted drug delivery, basic enzyme studies & hormones

Methods for enzyme immunoassay of testosterone have been standardized by IICB and the protocol and reagents sent to the CSIR Centre for Biochemicals for evaluation toward possible devevelopment of commercial kits.

Polyclonal antibody to alpha foetoprotein (AFP} which can serve as a marker for certain types of tumour of liver and the gastrointestinal tract, has been raised. AFP has been purified by a new method and work has been undertaken toward developing monoclonal antibody to it.

Neurobiology

Evidence has been obtained at IICB to suggest that tubulin and tubulin mRNA contents appear to be maximal during the mid-phase of synaptogenesis indicating that the rise in tubulin content may be associated with the naturally occurring triiodothyronine - induced increase of the protein.

There is evidence that the drug metoclopramide may release GABA which in turn releases ACH inducing increased mobility of the gastrointestinal tract.

Plant Pathology

Fifty-two new isolates of *Claviceps paspali* isolated recently were screened (CIMAP) for ergot alkaloids production in 'submerged culture. The production of alkaloids by these strains varied from 90 to 950 mg/1.

Elicitors are known to play an important role in disease resistance mechanism in plants. The elicitors were isolated from *Gleosporium gloeosporioides,* a pathogen causing antracnose of *Dioscroea composita.* The elicitor compound isolated was characterised as glucans. The elicitor preparation can be used as a tool for inducing resistance in plants against pathogen.

Screening of aqueous, hexane and alcoholic extracts of ninety plants for antiviral agents was carried out. Significant activity was observed in four plants, Scilla indica, Operculina turpethum, Lawsonia alba

four plants, *Scilla indica, Operculina turpethum, Lawsonia alba* and *artemisia annua.*

Glomus aggreqatum, a vesicular-arbuscular mycorrhiza (VAM), was isolated from palmarosa growing under field conditions and its effect on the growth and phosphorus.uptake was evaluated. The VAM-fungus enhanced growth and phosphorus uptake of palmarosa'plants by a factor of two.

Genetics and Plant Breeding

Based on distribution of constitutive heterochromatin, the 10 diploid species of *Papavar* could be phylogenetically categorised into three species - groups: L *P. naudicaule, P. kemeri. P. alpinum* and *P. trinifolium.* II. *P. spicatum* and P. *atlanticum* and III. P. *braeteatum, P. rhoeas, P. dubium* and P. *somniferum.* Gradual diminution of amount and number of C-band positive segments was found to be the probable reason for speciation in *Papavar.*

A true breeding diploid (2n=22) interspecific hybrid between *Papavar somniferum* (2n=22) and *P. satigerum* (2n=44) has been established. Amazingly, this hybrid is highly fertile and possesses desirable combination of many characters. Gross spindle disturbances both at A-II and M-II do not seem to adversely influence its fertility. Perhaps duplicate loci are involved in fertility system of opium poppy.

Biochemical and Immunological Studies on Plant Viruses

Geminate particles have been found (NBRI) to be associated with yellow mosaic disease of *Dolichos lablab.* Virus was purified following PEG precipitation, ultracentrifugation and sucrose density gradient. UV absorption of purified preparation was typical of nucleo protein and A260^280 rati° was 1-46. Electron microscopy revealed the presence of 12 nm particles in upper band and 20 x 40 germinate particles in lower band in sucrose gradient. Particles of 12 nm seemed to be phytoferritins which increased multifolds as a result of geminivirus infection. Antiserum against virus could not be raised in rabbits.

Taxonomic and Morphological Studies of Lichens, Bryophytes and Pteridophytes

About 200 lichen specimens belonging to genus *Pyrenula,* borrowed from various foreign as well as Indian herbaria were investigated. Nine species of the *Pyrenula* subducta spore type were described, seven of which namely, *P. defossa, P. immersa, P. improssa, P. interducta, P. mastophorizans, P. minarum* and *P. zeylanica are new* records for the Indian Lichen Flora. Five species of the Lichen genus *Peltula* and two of *Heppia* were described in detail from the Indian subcontinent, out of which four species of *Peltula* namely, *P. obscurans, P. patellata, P. tortuosa* and *P. zahalbruckneri* and one of *Heppia (H, lu'tosa)* are new records for the Indian Lichen Flora. 30 bryophytes were collected from different localities of Amarkantak (M.P.) and neighbouring areas. Monographic studies of the genus *Frullania* included further identification and critical studies of 7 species of which 5 species namely, *F. duthiana, F. hattoriantha, F. physantha, F. retusa, F. yuenanensis* are from Himalaya and 2 species, *F. muscicola* and *F. tamarisci* from Amarkantak (Madhya Pradesh).

Detailed studies on vascular organisation of the rhizome of two species of *Belvisia* and *three species of Microgromma* Prost, were completed.

Studies like multiphase reactors, polymer mineral interaction, characterisation of high silica aluminosilicates, mitomycin analogues, hydrocarbon transportation in microorganism, ethanol fermentation, microbial transformation of sterols, kinetics of anaerobic digestions, synthesis of artemisinin analogues, fast growing plants for paper making, tissue culture of economic plants, plant breeding, cyto, patho and physiological aspects of economic plants, environmental pollution aspects for muga silk worm and its food plants, synthesis of antimicobial chemicals, crude rheology and thermal conditioning, insecticidal compounds, growth promoting substances, earthquake hazard evaluation and predictions etc. were undertaken by RRL, Jorhat.

NATIONAL FACUJTES

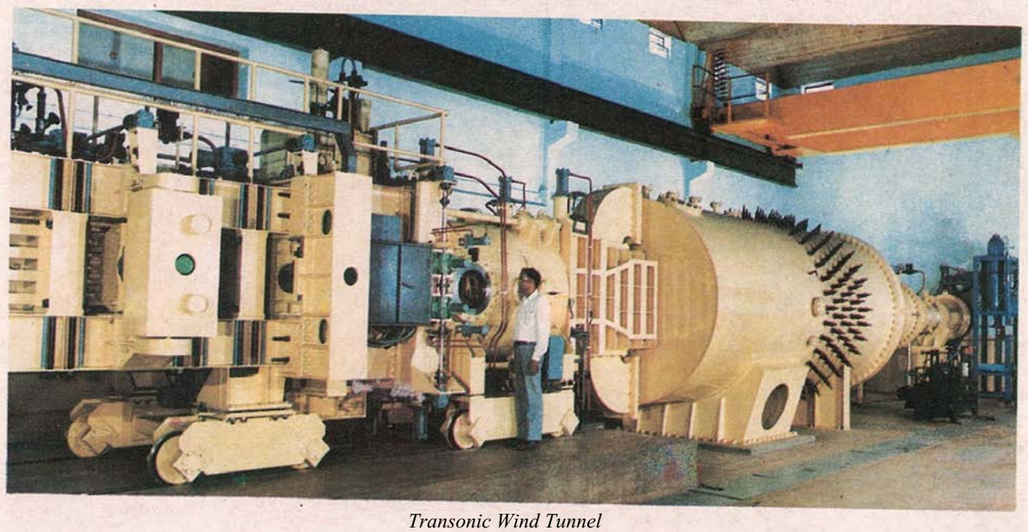
CNC Milling Machine Facility

CSIO has been providing CNC milling machine facility commissioned in March 1988. It comprises one FP3NC Universal Milling & Boring machine with Grundig Dialog 4 control with Computer graphics simulation facility for machining programme, one PC-AT (DOS 3.3) and one PC-XT (DOS 3.3), with DTS software for CNC programming and Geometry software, one printer FX 800, one tape puncher cum reader FACIT, one video network for 8PC-XTs and two monitors (Coloured 67 cm).

The CNC Machine Training Cell was inaugurated in June 1988. About seventy trainees have been imparted training in CNC application. The training comprises the general theoretical teaching in CNC technology appreciation, programming on PCs with DTS software; specific machine based instructions on operations and controls of the machine etc. A short term course of the duration of two weeks on CNC technology applications (for persons from allied disciplines) has also been planned.

Transonic Wind Tunnel

A new transonic wind tunnel with test section size of 0.6m x 0.6m has just been commissioned at NAL. The facility designed at NAL, is of blowdown type and capable of generating controlled flow at subsonic and transonic speeds (Mach number 0.2 to 1.2). The unit Reynolds number ranges from 6 x 106/meter to 80 x 106/meter. The construction of this wind tunnel was conceived with the objective of augmenting the existing capability of the 1.2 m trisonic wind tunnel of the National Trisonic Aerodynamic Facilities (NTAF) to meet the growing demands on tunnel without a significant loss in Reynolds number capability. The smaller - test section offers the added advantage of longer tunnel test runs. Substantial tunnel time will now be available for sponsored projects as well as R&D programmes.



Transonic Wind Tunnel

Gene Bank (MTCC)

Microbial Type Culture Collection/Gene bank (MTCC) began its operations at IMT in the year 1986. The start up laboratory is fully functional and is equipped with modern facilities necessary for preservation and characterization of bacteria, yeast, actinomycetes and fungi.

During the year under report, the programme for acquisition of strains from recognized national and international collections was continued and MTCC collected, checked- and maintained a total of about 500 strains. In addition to strains for general use, strains useful for recombinant DNA research as also for teaching and demonstration purposes were acquired. Second edition of catalogue of strains available for distribution was printed and distributed to users.

National Laboratory Animals Centre (NLAC)

The New Wing of NLAC was set up in CDRI in collaboration with DBT and was dedicated to the nation by the Chief Minister of U.P. Shri Narain Dutt Tiwari. The additional space of 34000 sq ft will be used to house a basic stock of various strains. The facility has enabled the provision of specific pathogen free (SPF) and germ free (gnotobiotic) rodents for critical experiments.

About 2538 animals of different species (rodents, mastomys, cotton rats, Balb/c mice) and blood samples, tissues etc. were supplied to research laboratories in the country. Consultancy services were provided to 2 institutions on establishment of laboratory animal facility and supportive facilities for x-ray, tuberculin and laboratory tests of animals were provided to 142 institutions.

DISSEMINATION OF INFORMATION

PID continued to publish the following eleven journals; the periodicity of each journal, and volumes corresponding to 1988-89 are given in parantheses : (1) *Indian Journal of Pure & Applied Physics* (monthly, Vol. *26-27): Indian Journal of Radio & Space Physics* (bimonthly, Vol. 17-18); (3&4) *Indian Journal of Chemistry - Sections A&B* (monthly, Vol. 27-28); (5) *Indian Journal of Experimental Biology* (monthly, Vol. 26-27); (6) *Indian Journal of Biochemistry & Biophysics* (bimonthly, Vol. *25-26): (7) Indian Journal of Marine Sciences* (quarterly, Vol. 17-18); (8) *Journal of Scientific & Industrial Research* (monthly, Vol. 47-48); (9) *Research & Industry* (quarterly. Vol. 32-33): (10) *Indian Journal of Technology* (monthly, Vol.26-27); and (11) *Indian Journal of Textile Research* (quarterly, Vol. 13-14).

The Indian Journal of Biochemistry & Biophysics published its December issue as 'silver jubilee' issue, containing 44 papers (pp.260) by leading schools of research in India and abroad.

The other periodicals that were issued include: *CSIR News* (semi-monthly. Vol. 38-39). *CSIR Samachar* (semimonthly, Vol. 5-6) and *Medicinal & Aromatic Plants Abstracts* (bimonthly, Vol. 10-11).

The Directorate brings out three popular science magazines: *Science Reporter* (English, Monthly, Vol. 25-26), *Vigyan Pragati* (Hindi, monthly, Vol. 37-38) and *Science ki duniya* (Urdu, quarterly, Vol. 13-14). The No\ember 1988 issue of *Vigyan Pragati* was a special number on Sir C.V. Raman. The February 1989 issue of *Science Reporter* was a special number on National Science Day ((28 February 1989).

Under the Science and Technology Archival Resources (STAR) project, a comprehensive data base of S&T records available in National and State archives is being de\ eloped by NISTADS. About 10,000 records have been entered.

INSDOC compiled the Commemoration Volume of CSIR entitled "In search of knowledge: CSIR contribution'* containing401 significant papers published by CSIR scientists since 1950, selected by citation analysis of over 4000 papers. The publication contains 5 Volumes and one Index volume. A data base of 890 records containing the bibliographic information of the selected papers has been created.

The first meeting of SAARC documentation expert committee was held in INSDOC, from March 9-11, 1988. INSDOC was designated as the national focal point for SAARC documentation centres.

INTERNATIONAL NATIONAL SYMPOSIA/WORKSHOPS

An International Symposium on Industrial Metal Finishing was organised at CECRI, Karaikudi from 1st to 5th February 1989. 153 scientists of various institutions from India and 4 from abroad participated. 45 research papers were presented and discussed.

NGRI hosted the following International workshops/symposia; International workshop on Deep Electromagnetic Exploration, December 19-21, 88;

International symposium on Structure and Dynamics of the Indian Lithosphere, Feb 1-3, 89;

International workshop on "Appropriate Methodologies for Development and Management of Groundwater Resources in Developing Countries", Feb 28-Mar 4, 89;

Commonwealth Science Council planning meeting and training programme and workshop on computer applications for geological/geophysical Data Management, Mar 7-12, 89

An Indo-Soviet Workshop on "mathematical models in biology and medicine" was held in IICB between 21 and 24 February 1989. An Indo-Soviet Symposium in genetic engineering was held in the Institute between 15 and 18 March 1989.

In 'Indo-US Workshop on Cell-mediated Immunity in relation to Tropical Disease' sponsored by CSIR, DST, US India Fund and Uniformed Services University of Health Sciences, Bethesda, Maryland, USA was held at CDRI, Lucknow from 10th to 14th October 1988.

GENERAL

A meeting of the CSIR Society, presided over by the Prime Minister (President, CSIR Society), was held on 24 February 1989.

The Governing Body of CSIR met on 4 July 1988 and 24 February 1989.

The 40th Conference of Directors of National Laboratories was held on 5 and 6 July 1988.

PLANNING

The Planning Division was entrusted with the responsibility of formulating the 8th Plan programmes (1990-95) of CSIR. Two meetings of the Working Group constituted by the Planning Commission were held to consider and finalize the draft documents prepared by the Division. The plan was presented by DGSIR and was approved with minor modifications. The division also prepared the Annual Plan 1989-90 keeping in view the priorities to be assigned to programmes in the 8th Plan.

The formulation of the 8th Plan followed an interaction with the Planning Commission and other ministries/departments of the Govt, of India. An extensive exercise was also undertaken by the division in giving a shape to the future programmes of the laboratories and their involvement in various societal/technology missions.

The Division continued to make steady progress in monitoring the progress of mission programmes and reporting the same to the inter-ministerial committees set up for the purpose. As a result of the efforts of the Division, tangible results were brought to focus in the Water Mission and Technology Mission on Oilseeds. Reports were being forwarded with regularity to the Prime Minister's office and the Ministry of Programme Implementation.

The division organized special training programmes for computerization of plan data and software for planning, monitoring and library arid other information activities. These programmes were organized at different locations and a number of junior scientists were invited to attend.

The Division provided scientific and technical inputs to the functioning of the various Technical Advisory Boards. This involvement contributed to the emergence of a few identified thrust area programmes to be taken up by the laboratories during the remaining part of the 7th plan and the 8th plan period.

A series of special publications dealing with the Significant Achievements of CSIR, important developments in various areas in the country and in CSIR during the last 40 years, and Research Output of the laboratories based on bibliometric analysis of the papers published during the previous year, were brought out due to the efforts of the scientists of the Division.

TECHNOLOGY UTILISATION DIVISION (TUD)

During the year the Technology Utilisation Division had taken several initiatives to promote the utilisation of CSIR knowledge base. Some important activities were:

CSIR - ASSOCHAM Interaction

In association with the Associated Chambers of Commerce (ASSOCHAM), CSIR worked out a model agreement to facilitate individual units availing CSIR expertise for quality improvement and upgradation. Initially two product areas, Testing and Measuring Instruments and Electrical Appliances, have been taken up.

CSIR - KVIC Collaboration

Recognising that S&T inputs from CSIR could significantly improve the productivity and products of the village industries, CSIR and KVIC

are collaborating to provide S&T inputs for the leather, food and building materials sector. A high level Steering Group has been set-up to monitor the progress of this collaboration.

World Bank (WB) Assistance for Industrial Technology Development

The Division coordinated and negotiated with the WB mission loans to NCL ($ 5.5 m), NML ($ 2.3 m), CLRI ($ 4 m), CMRS ($ 0.7 m), besides a grant of around 1 million dollars for the development initiatives in: Technology Marketing and Management ($ 0.3 m), Laboratory Safety Implementation and Monitoring Programme ($ 0.4 m) and Laboratory Management Systems (NCL).

Technology Transfer and marketing of CSIR knowledgebase

In order to be more user responsive, new guidelines for technology transfer and marketing, giving the laboratories devolution of autonomy in decision making and the requisite flexibility in oprational procedures were framed by the Division and approved by the Governing Body. Besides, a consultative mechanism in the form of an annual meeting of staff in charge of marketing the knowledgebase has been institutionalised to devise a strategy for the marketing of knowledgebase.

Interaction with NRDC/Laboratories

As a result of enhanced interaction and consultation with NRDC and laboratories, over 220 licence agreements covering 125 processes/knowhow were executed and 16 new knowhow/proccsses were made available for licensing to industry. The Division assisted the laboratories in negotiations with clients and drafting of contracts for over 100 research and consultancy projects.

Interministerial Linkages

TUD participated in interministerial committees dealing with Industrial Approvals such as Technical Evaluation Committee, Foreign investment Board, Special Approval Committee (SAC) for NRI etc. wherein its main role has been to endeavour to prevent import of technology in cases where the technology was available in the CSIR and also to inform the Government and industry at an appropriately early stage of the availability of knowhow with CSIR.

The Division examined around 1000 proposals for importing technology, over 2000 industrial licences, 38 (NRI) and 10 industrial delicensing applications received from the Govt, of India, and participated in 18 FIB, 12 SAC, 51 TEC meetings. It also examined around 400 applications from industrial units seeking registration of their inhouse R&D units and participated in 10 meetings of the Inhouse R&D Recognition Committee.

Patent Unit

The patent unit of TUD has established a computerised database on Indian Patents published since 1972, under the Patents Act 1970. The database enables a patent search for any area or sub-area to be made. A volume on Indian Patents in the field of Biotechnology granted since 1972, was also brought out.

Polytechnology Transfer Centres

The Polytechnology Transfer Centres functioning in 9 state capitals, while continuing their efforts in helping industries in problem solving extended their assistance to CSIR's efforts in the Missions on Oilseeds and Drinking Water. PTCs made over 500 visits to the industry and solved 300 out of 400 identified problems.

INTERNATIONAL SCIENTIFIC COLLABORATION

A CSIR delegation led by Dr. A.P. Mitra, DGSIR with Dr. A.P. Joshi and Dr. S.K. Rao as members visited Peru in February 1989 on the invitation of the President of Peru National Council of Science & Technology (CONCYTEC). On conclusion of their visit an agreement of S & T cooperation was signed between CSIR and CONO 1 EC at Lima. The areas included for co-

operation are: Material Sciences, Applied Physics, Earthquake Prediction & Building Systems, Aeronomy, Oceanography, Mining and Metallurgy, Chemical Sciences and Biological Sciences.

As a follow up of the visit of Prof. Staab, President of the Max Planck Society (MPG) of FRG, CSIR and the Max Planck Society have reached an understanding for cooperation in areas of common interest through exchange of letters in May 1988. The areas of cooperation include VLBI, Superconductivity, Mathematical Modelling, Engineering Ceramics and biological sciences.

Formal exchange of letters for extension of the agreement was concluded between Dr. B.L. Amla, Director, CFTRI, Mysore and the Rector of the United Nations University, Tokyo for CFTRI acting as an associated institution of UNU after 31.12.1989 for providing six UNU fellowships with the support of CSIR in the area of Food Technology.

Under the India-Egypt S&T agreement a fresh working programme for the year 1988-90 for S&T cooperation between CSIR and the Academy of Scientific Research and Technology (ASRT) of Egypt was signed in New Delhi on 20th April 1988 by Shri K.R. Narayanan, Vice President, CSIR and the Minister of State for S&T and HE Adel Abdel - Hamid Ezz, Minister of State for Science & Technology of ARE. Areas included in the working programmes are metallurgy, Petroleum Research, Geophysics, Oceanography, Instruments etc.

The programme of scientific cooperation between CSIR and the Polish Academy of Sciences was reviewed on 26th September 1988 in Poland and a fresh programme was signed by Dr. K.I. Vasu, Director, CECRI on behalf of CSIR and Prof. W. Zielenkiewicz on behalf of the Polish Academy of Sciences. The areas identified for cooperation were Biological Sciences, Catalysts, Hydrometallurgy, Coal Structure, Reactivity during Chemical Processing, Natural Products, Acoustics, Earth Sciences, Non Ferrous Metallurgy, Statistics, Aeronautics and Urban & Regional Planning.

Collaborative Projects

A regional project on 'Development of Rural Road Infrastructure[4] executed by the Economic & Social Commission for Asia and the Pacific (ESCAP), Bangkok and funded by UNDP has commenced from May 1988 at CRRI. The project aims at strengthening the training as well as R & D of selected Road Research Institutes. The participating countries are China, Bangladesh, Indonesia, Iran, Pakistan, Philippines, Srilanka, Thailand and India.

A joint project entitled 'International Cooperation in technology transfer for production of Indigenous Building Materials and Components in developing countries' was agreed to by CSIR with UNCHS and GOSCOMARCHITECTURE & GOSSTROY of Latvian SSR during February 1989. The laboratories involved on the CSIR side are CBRI, SERC (Madras) & RRL (Jorhat) and on the USSR side the Lativan Building Research Institute.

In addition to 6 ongoing UNDP assisted projects involving assistance of $ 8 millions, a proposal for extension of TOKTEN project (Phase III) - $ 0.5 million and two new projects - Establishment of surface analytical facilities at NPL (S 1 million) and Application Specific Integrated Circuits (ASICS) for process industries at CEERI have been approved for UNDP assistance under CP IV (India) Programme.

Commonwealth Science Cooperation Programmes

A Commonwealth India Metrology Centre (CIMET) was established at NPL as successor to the Asia Pacific Metrology Programme of the Commonwealth Science Council. The first of the CSC regional programmes to be domiciled in a developing country, CIMET will promote cooperation in the area of metrology among Commonwealth countries including group and individual training. The Centre was inaugurated by the Vice President, CSIR and Minister of State for S&T Shri K.R. Narayanan in the presence of

Shri S. Ramphal, Secretary-General of Commonwealth on 23rd February 1989.

Under the Commonwealth Science Council programme on Awareness of Rapid Advances in Science & Technology (Arast) an international high level workshop was organised in the area of 'Biotechnology and Allied Sciences' from 23rd to 27th Tanuary 1989 at NCL, Pune for Commonwealtfi countries. It was inaugurated by Sir John Ken drew, Nobel laureate.

Under the industrial support programme of CSC a training workshop on 'Animal By-products utilisation' for developing Commonwealth countries was organised at CLRI* Madras during 6-20th March 1989. A manual on 'Processing of animal by-products in developing countries' brought out by CLRI for CSC was also released by DGSIR.

South Asian Association of Regional Cooperation (SAARC)

A SAAiC training programme on 'Low-cost housing' was organised at CBRI, Roorkee during 9-18th September 1988.

A meeting of the Steering Committee of the SAARC Documentation was organized by CSIR at INSDOC during March 9-11, 1988.

Raman Research Fellowship

CSIR has instituted the Raman Research Fellowship to enable CSIR scientists to work in emerging high priority areas in laboratories/universities and research institutions abroad where advanced research is being carried out and research facilities are available in frontier areas. The first batch of 4 fellows has been selected.

CSIR Fellowship Scheme for developing countries •

CSIR has recently instituted hundred (100) fellowships to enable scholars from developing countries to work in CSIR laboratories/institutes for their Ph.D. The stipend is the same as for CSIR junior/senior research fellows.

During the year sixty foreign candidates were trained in CSIR laboratories under the sponsorship of UN agencies and Indian assistance programmes and foreign aid agencies. The areas covered were Drugs & Pharmaceuticals, Extraction of Medicine from plants, Instrumentation, Glass blowing, Food Storage & Processing, Milling, Tannery and Geophysical investigations.

EXTRAMURAL RESEARCH PROGRAMMES

Sixteen research committees of the EMR Division functioned during the year. About 840 research projects were supported and grants provided during the year. More than 1200 fellows and associates were collaborating with principal investigators of their projects. Besides, 60 superannuated scientists/academicians were provided grants under the Emeritus Scientist Scheme.

The number of research fellows/associates selected directly and receiving financial assistance from CSIR as on 1 March 1989, was 3674 in acadeiijic institutions other than the CSIR laboratories. Besides, 300 research fellows/associates are in position in CSIR laboratories/ institutes bringing the total to 3974.

Grants were sanctioned for the organisation of 213 national and international symposia/ seminars, conventions, congresses, conferences, meetings, workshops, special courses etc. with sanction of grants ranging from Rs.5000 to Rs. 50,000 in each case.

Under the scheme of travel grants to young Research Scholars, not employed on regular basis, grants were sanctioned to 202 applicants during the year for presenting papers at international conferences, seminars etc.

Grants were proposed to 20 Indian language Journals for popularization of science during the year. Of these 5 were in Bengali, 4 in Malayalam, 3 in Hindi, 2 in Tamil and 1 each was in Gujarati, Oriya and Kannada.

Shanti Swarup Bhatnagar Award

A function was held on 17th October 1988 at Vigyan Bhawan, New Delhi, to award the Shanti Swarup Bhatnagar Prizes for 1987 to the following scientists. The awards were given away by Shri Rajiv Gandhi, Prime .Minister.

Physical Sciences	Prof. Vijay Kumar Kapahi Tata Institute of Fundamental Research Centre, Post Box No. 1234, Indian Institute of Science Campus, Bangalore-560012
	Prof. Probir Roy Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay-400005
Chemical Sciences	Prof. Debashis Mukherjee Department of Chemistry, Indian Association for the Cultivation of Science, Calcutta-700032.
Biological Sciences	Prof. Sudhir Kumar Sopory School of Life Science, Jawaharlal Nehru University, New Delhi-110067
	Prof. Avadhesha Surolia Molecular Biophysics Unit, Indian Institute of Science Bangalore-560012.
Engineering Sciences	Prof. SHrikant Lele Department of .Metallurgical Engineering, Banaras Hindu University, Varanasi-221005.
Mathematical Sciences	Dr. R. Parimala School of Mathematics, Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay-400005.
	Prof. Tarlok Nath Shorey, School of Mathematics, Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay-400005.
Earth Sciences	Prof. Pramod Sadasheo Moharir Department of Earth Sciences, University of Roorkee, Roorkee-247667.

Scientists' Pool

During the year, 393 persons trained abroad were registered for the Scientists' Pool. A total of 209 persons, including 52 registered earlier, were selected to the Scientists' Pool - 80 of them in absentia while they were still abroad. Among the 209 persons selected, 160 returned to India, 84 joined the Pool, 34 were expected to join on securing placement in suitable institutions, and 42 did not join the Pool. A hundred and ninety one (191) highly qualified persons, trained in India were also selected and.joined the Pool. The number of Pool Officers working as on March 31, 1989 was 635. Of them about 47 per cent were Scientists, nearly 46 per cent medical personnel, and 7 per cent engineers and technologists. About 285 Pool Officers left the Pool during the year, either after securing regular employment or after completing their tenure in the Pool. Since its inception in 1958, 8704 highly qualified persons have availed of the Pool Scheme.

A number of improvements have been effected in the operation of the Pool Scheme with a view to making it more attractive. They are:

Speeding up of the process of selection and placement by computerising all the steps involved.

Reduction of possible delay in the payment of salary to Pool Officers by computerisation of all relevant data.

Raising of the upper limit of the salary range to Rs. 6300 pm from Rs. 5000 pm to bring it on par with the maximum salary of "Scientist-F" grade of CSIR, (as an incentive to experienced Indian scientists and technologists settled abroad to return to India) and grant of basic salary equivalent to that of Senior Residents in hospitals to a majority of medical Pool Officers in order to attract highly qualified and experienced Indian doctors from foreign countries.

Under the TOKTEN-India (Transfer of knowledge/know-how Through Expatriate Nationals) project, a joint programme of the Government of India and the United Nations Development Programme, a total of 37 Indian consultants visited 65 Indian institutions. They advised them on new laboratory processes and pilot plants, and on specific problems faced by the research institutions. New laboratory protocols were demonstrated and transferred by nine consultants. Specific R&D problems were solved by 12 consultants. One consultant gave a three-week training course including practical demonstrations in gene isolation. Sixteen consultants continued to maintain contacts with their counterpart organisations in India after their visit. Thirty Indian researchers visited the foreign laboratories of the consultants for scientific discussions or for advanced training. In some of these cases, consultants provided financial support to the visiting Indian scientists.

Statistical tables pertaining to the social scientists of the 1981 "Degree Holders and Technical Personnel Survey" were published.

Preliminary discussions with the user organisations on the questionnaire to be floated for the 1991 survey have been completed, and a draft questionnaire is being prepared.

Manpower Studies

Revision of the "Directory of CSIR Scientists", comprising six volumes, is nearing completion. Four volumes, one each for Information Science, Physical & Earth Sciences, Chemical Sciences, and Biological Sciences, duly revised and updated, have been published. The fifth volume relating to Engineering Sciences, and the sixth containing names and specialisation indexes, are being finalised, and would be published shortly. Together the six volumes present detailed characteristics of about 7000 CSIR scientists including qualifications, professional attainments, present activities, and research publications.

Floppy disks, bearing information on CSIR scientists, are being made available to all the laboratories for reference and periodic revision. The computer-based information is also being made available at the national level through the National Informatics Centre Network (NICNET), which would facilitate location of specialists in different fields.

A volume on about 1000 young scientists of CSIR was also published during the year.

Five issues of "Technical Manpower" and two issues of the "Directory of Indian Scientific and Technical Personnel" were also published.

Four separate volumes, one each for science, engineering & technology, medical sciences, and agriculture & veterinary science, containing outturn data on Indian graduates and postgraduates for the period 1947 to 1983 are being published. Collection of outturn data for the period beyond 1983 is continuing.

Data on research fellowships in science subjects. awarded in India during 1975-85, have been compiled, and are being integrated with similar data being collected by the Indira Gandhi National Open University for a comprehensive study on the usefulness of research fellowships.

Employment Assistance

Biodata of 342 scientific and technical personnel were furnished against 94 vacancies notified to the Division to facilitate their absorption in regular posts. This included 240 working Pool Officers and 102 non-pool personnel.

Twenty highly qualified Indian scientific and technical personnel working/settled abroad sought the Division's assistance to find permanent positions in India. Their curricula vitae were circulated to one hundred and thirty two organisations in the country to facilitate their permanent absorption.

PUBLIC RELATIONS (PR) UNIT

CSIR's participation was organised in nine exhibitions in the country and two abroad. Among the exhibitions CSIR's participation was appreciated in 'National Agriculture Fair' held in Pragati Maidan during March 1989 and Science & Technology Exhibition to mark the Nehru Centenary Year in Ahmedabad and S&T exhibition during the Indian Science Congress in Madurai in the month of January, 1989. In the Madurai Exhibition, the CSIR pavilion was declared the best pavilion. The 'Water and You' Exhibition held in Teen Murti House during 14-29 November, 1988 was highly acclaimed by the Prime Minister.

Some of the important films produced during the year were 'Quest for Hi-tech* 'Drinking water from the Sea, RO Plant Presentation to Thailand'. 'Mobile Water Testing Lab (ITRC)', and 'MMAHA Workshop' sponsored by UNESCO.

NEW MOUs

CSIR HAS ENTERED INTO MEMORANDUM OF UNDERSTANDING (MOUs) WITH

* DEPT. OF ENVIRONMENT FOR ESTAB- L1SHING A CENTRAL WATER LABORATORY.

* CENTRAL BOARD FOR WATER POLLUTION FOR ENVIRONMENTAL MANAGEMENT STUDIES.

* ONGC FOR -

  - ENVIRONMENTAL STUDIES
  - ENVIRONMENTALLY VIABLE BIOCIDES

* NAVODAYA VIDYALYA (NV) SAMITI FOR DESIGN OF NV COMPLEXES

DEPT. OF NON-CONVENTIONAL ENERGY SOURCES FOR ESTABLISHING A WIND ENERGY CENTRE.

DRDO FOR BENEFICIATION OF TUNGSTEN ORES.

* SAIL FOR COLD BONDED PELLETS

* DEPT. OF BIOTECHNOLOGY FOR ESTABLISHING PILOT FACILITY FOR PLANT TISSUE CULTURE

ROLL OF HONOUR

Indian National Science Academy — Fellowship (FNA)

V.P. Khamboj, CDRI Lucknow
C.M. Gupta, CDRI Lucknow

Indian Academy of Sciences, Bangalore — Fellowship

A.V. Narlikar, NPL, New Delhi
A.N. Bhaduri, IICB. Calcutta
J. Das. IICB, Calcutta
Lalji Singh, CCMB, Hyderabad
Paul Ratnasamy, NCL, Pune
R.N. Singh, NGRI, Hyderabad

INSA Young Scientist Award

(Ms.) Madhu Dixit, CDRI, Lucknow

CSIR Young Scientist Awards

Anand Akhila, CIMAP, Lucknow
Ashok Joshi, NAL, Bangalore
Dilip Kumar NIO, Goa
Ganesh Prasad Pandey, RRL, Hyderabad
Nagaraj R, CCMB, Hyderabad
Ravi Malhotra, NPL, New Delhi
Shyam S. Rai, NGRI, Hyderabad

Unesco/ROSTSCA Young Scientist Award

(Ms.) Sudha Jain, CDRI, Lucknow

FICCI Award

M.R. Das, CCMB, Hyderabad

VASVIK Award

(Ms.) Malathy Pushpavanam, CECRI, Karaikudi

Hindustan Lever Award (1988)

Dr. K.V. Raghavan, of CLRI, Madras received the award of ''The Most Outstanding Chemical Engineer of the Year".

Young Scientist Award of Academy of Environmental Biology

Dr. K.S. Jagannath Rao, CFTRI, Mysore

Dr. M.D. Zingde of NIO, Goa received the first prize of the Hari Om Ashram Prerit Shri S.S. Bhatnagar Research Endowment Award.

Dr. R Krishna, Director, IIP has been elected Fellow by Indian Academy of Sciences from 1989.

Excellence in Technology Award To IIP

IIP and EIL got the first award jointly for excellence in technology development of the process for extraction of aromatics from naphtha streams with sulpholane, a technology being implemented successfully by industry. The award was instituted by the Department of Chemicals and Petro Chemicals, Govt, of India in commemoration of the 40th year of Independence.

APPENDIX -1

PROCESSES & KNOW-HOW REPORTED IN PRODUCTION FOR THE FIRST TIME DURING 1988-89

S.No.	Know-how/Process	Party	Nature* of Licence
I. CHEMICALS			
	CECRI		
1.	Calcium chromate pigment/ iron oxide primer	Nova Paints, Trichy	NE
	NML		
2.	Corrosion inhibitor- [1] Metasave*	Metoil Corporation, Jamshedpur	NE
3.	Rust stabilizer- 'RustoF	Mikasu Metreat, Jamshedpur	NE
	NCL		
4.	Detection kit for narcotic drugs	Hindustan Antibiotics Ltd Pimpri	IL
	CSMCRI		
3.	Potassium nitrate by chemical reaction	Vimal Industries Equipment Pvt. Ltd., Bombay	NE
II. FOODS & BEVERAGES			
	CFTRI		
6.	Potato chips, dehydrated	Swaroop \ egetables, Muz affarn agar	NE
	RRL, Trivandrum		
7.	Coconut oil-perfumery grade	Mahendra Industries, Trivandrum	NE
III. BUILDING MATERIALS			
	CGCRI		
3.	Alumina bricks from sillimanite	M.H. Detrick (1) Ltd., Calcutta	NE
IV. ELECTRONICS & INSTRUMENTATION			
	CEERI		
9.	Klystron ampilifier tubes, IKW, CW D/E band	Bharat Electronics Ltd., Bangalore	NE
	NEERI		
10.	Water analysis kit	S.S.K. Plastics, Nagpur	NE
V. EQUIPMENT			
	CECRI		
11.	Corrosion resistance probe	Systems Control, Bangalore	NE
	CEERI		
12.	Panometer - AC resistivity equipment	Computer Controls (India), Ghaziabad	NE
VI. MATERIALS			
	CECRI		
13.	Zinc alloy anodes	Hindustan Alloy Mfg. Co. Ltd., Bombay	NE
VII. METALS *8c* ALLOYS			
	WL		
14.	Tin from tin sludge	Tin Plate Co. of India Ltd., Jamshedpur	NE
VIII. OTHERS			
	CIMAP		
15.	Lavender cultivation/ processing of	S.H. Kelkar & Co. Ltd., Bombay	NE

* E - Exclusive
NE - Non-Ex elusive

APPENDIX - II

PROCESSES LICENSED TO INDUSTRY FOR THE FIRST TIME DURING 1988-89

S.No.	Know-how/Process	Licensed to	Nature* of Licence
I. CHEMICALS			
	CBRI		
1.	Fire retardant paints	Chibber Chemicals P. Ltd., Delhi	NE
	CSMCR1		
2.	Epsom salt	Tuticorin Salt & Marine Chemicals Ltd., Tuticorin	NE
	RRL, Jorhat		
3.	D iosgen in	Tripura Forest Development & Plantations Corpn. Ltd., Tripura	NE
	RRL, Hyderabad		
4.	Touch-up fluid- formulation-	Survey of India, Hyderabad	NE
5.	Timolol Maleate	F.D.C. Pvt. Ltd., Bombay	E
6.	Metaphen oxy benz al-dehy de	Gujarat Aromatics Ltd., Atul	E
7.	Synthetic rubber based adhesive	Shri Syed Abdul Qader, Hyderabad	E
	NAL		
8.	Descaling of diesel locomotive engine components	Southern Railways	NE
	NCL		
9.	2,6 Diethyl aniline	Navin Chemical Enterprises, Ahmedabad	E
10.	Controlled release pesticide formulations of quinalphos & disulfoton	Sandoz (India) Ltd.. Bombay	E
11.	Controlled release coating formulation for fruit packaging	Rallis India Ltd., Bombay	NE

S.No.	Know-how/Process	Licensed to	N atu re * of Licence
12.	Catalyst for toluene oxidation to benzaldehyde	Indian Organic Chemicals Ltd., Bombay	NE
13.	High fructose corn syrup	Indian Organic Chemicals Ltd., Bombay	E
14.	B-Chlorotheophylline	Unichem Laboratories, Bombay	NE
15.	Detection kit for narcotic drugs	Hindustan Antibiotics Ltd., Pimpri	NE
16.	Isobutylbenzene	Filtra Materials Research Pvt. Ltd., Thane	NE
17.	Polymeric (Urethane type) plasticizer	Indo Nippon Chemicals Co. Ltd., Bombay	NE
18.	Polyacrylamide	FICOM Organics Ltd.. Bombay	NE
19.	New polymer support for penicillin acylase	Hindustan Antibiotics Ltd. (HAL), Pune	NE
	IIP		
29.	Hexane, food grade	i) Madras Refineries Ltd., Madras ii) BPCL, Bombay	NE
21.	Butyl cresol, di-tertiary 2,6 (BHT)	Balmer Lawrie *& Co.,* Calcutta	NE
22.	Butyl phenol, p-tertiary (PTBP)	Balmer Lawrie & Co., Calcutta	NE
	CLRI		
23.	Myrobalan/wattle tanning extract	My rob Extracts (I) Pvt. Ltd., Orissa	NE
	NPL		
24.	Black stamp cancellation ink	Mysore Lac & Paints Works Ltd., Mysore	NE
II. DRUGS & PHARMACEUTICALS			
	RRL, Hyderabad		
25.	Etoposide - an anti cancer drug	CIPLA Ltd., Bombay	E

S.No.	Know-how/Process	Licensed to	Nature* of Licence
III.	**FOOD & BEVERAGES**		
	CSMCRI		
26.	Salt - free flowing	SSFS, Kharagoda	NE
	RRL, Trivandrum		
27.	Coconut oil-perfumery grade	Mahendra Industries, Trivandrum	NE
IV.	**BUILDING MATERIALS**		
	CGCRI		
28.	High alumina cement	Refcom (India) Pvt. Ltd.. West Bengal	NE
	SERC(G)		
29.	Manhole covers, Ferrocement	UPC Concrete Products P. Ltd., Delhi	NE
V.	**ELECTRONICS & INSTRUMENTATION**		
	NALICEERII CECRI		
30.	Corrosion meter	Elico Pvt. Ltd., Hyderabad	NE
	NPL		
31.	Phosphors for monochrome T.V. picture tube	Arun Goel, New Delhi	NE
32.	Decoder for time dissemination via IN SAT-IB	Shy am Antenna Electronics Pvt. Ltd., New Delhi	NE
	NEERI		
33.	Rotating biological contactor	Kirloskar Brothers Ltd., Pune	NE
34.	Multipurpose water test kit	S.S. Khanna Plastics Pvt. Ltd., Nagpur	NE
	CECRI		
35.	Cadmium selenide photo-conductive cells	Electron India, Madras	NE
	CEERI		
36.	Display panel meter	V.K. Industries, Pilani	NE
37.	Digital pH meter	V.K. Industries, Pilani	NE
38.	Lever sensor indicator & transmitter	Satwik Electric Controls Pvt. Ltd., Nasik	NE
39.	Neutral to ground voltage detector	Satwik Electric Controls Pvt. Ltd., Nasik	NE

S.No.	Know-how/Process	Licensed to	Nature* of Licence
VI.	**EQUIPMENT**		
	NAL		
40.	Windmill (SAMIRA)	Dr. S.K. Tiwari, Bangalore	NE
41.	Electrochemical machinising equipment	Machine Tool Aids & Reconditioning, Hyderabad	NE
42.	Parrallel processing computer	WIPRO Information Technology Ltd., Bangalore	NE
43.	Eddy current precision wire tensioner	Sh. S.V. Sidhappa, Bangalore	NE
	RRL, Bhub.		
44.	Accoustic fuel burner	TISCO, Jamshedpur	NE
	CECRI		
45.	Corrosion resistance probe	Systems Control, Bombay	E
VII.	**PLANT & MACHINERY**		
	CBRI		
46.	Mini climbing crane	Sonmati Engg. Works, Allahabad	NE
	SERCfGj		
47.	Semi automatic building block making machine	Gomantak Lato Blocks Machine Co., Goa	NE
	CFTRI		
48.	Pulse dehusking machine	Eleven Parties	NE
VIII.	**MATERIALS**		
	CGCRI		
49.	Synthetic high alumina aggregates	Kumardhubi Fireclay & Silicon W'orks, Kumardhubi	NE
	CECRI		
50.	Al-Zn-In anodes	Hindustan .Alloy Mfg. Co., Bombay	NE

S.'N o.	Know-how/Process	Party	Nature* of Licence
IX.	**METALS** *8c* **ALLOYS**		
	NML		
51.	Manganese Metal, electrolytic	Indian Manganese Metal, Rourkela	NE
52.	Tin from tin sludge	Tinplate Co. of India Ltd., Jamshedpur	NE
X.	**OTHERS**		
	RRL, Trivandrum		
53.	Banana fabric composite products	Shree Kamla Industries, Jalgaon	•NE
	CFTRI		
54.	Curing & polishing of turmeric	J.B. Traders & Engg., Jamshedpur	NE
55.	Sunflower seed processing	i) Karnataka Co-op Oilseeds Growers Fed. Ltd., Bangalore	NE
		ii) Veg Oils Ltd., Bombay	
56.	Canning of Rasgulla	Supreme Baker's, Quilon	NE
	CIMAP		
57.	Ajmalicine from catharanthus roots	Nilgiri Phytochemicals Pvt. Ltd., Cochin	NE

* E - Exclusive
NE - Non-Exclusive

APPENDIX-III

CSIR PATENT APPLICATIONS FILED ACCEPTED AND SEALED DURING THE PERIOD 01-04-88 TO 31-03-89

LABORATORY	INDIA			ABROAD		
	Filed	Accepted	Sealed	Filed	Accepted	Sealed
CBRI, Roorkee	-	-	3	-	-	-
CFB, Delhi	2	-	-	-	-	-
CCMB, Hyderabad	3	-	-	-	-	-
CDRI, Lucknow	8	5	18	-	-	-
CECRI, Karaikudi	12	4	11	-	-	-
CEERI, Pilani	2	2	5	-	-	-
CFRI, Dhanbad	5	5	3	-	-	-
CFTRI, Mysore	3	4	7	-	-	-
CGCRI, Calcutta	4	-	1	-	-	-
CIMAP, Lucknow	1	-	1	-	-	-
CLRI, Madras	2	2	1	-	-	-
CMERI, Durgapur	2	2	6	-	-	-
CMRS, Dhanbad	2	3	1	-	-	-
CRRI, New Delhi	5	-	-	-	-	-
CSIO, Chandigarh	-	1	-	-	-	-
CSIR, Schemes	1	-	1	-	-	-
CSMCRI, Bhavnagar	3	2	5	-	-	-
IICB, Calcutta	3	-	11	-	-	-
IIP, Dehradun	1	3	5	-	1	-
IMT, Chandigarh	2	-	1	-	-	-
NAL, Bangalore	-	4	4	1	-	-
NCL, Pune	26	5	23	10	-	1
NEERI, Nagpur	-	-	2	-	-	-
NGRI, Hyderabad	-	-	2	-	-	-
NIO, Goa	1	-	-	-	-	-
NML, Jamshedpur	14	8	6	-	-	-
NPL, New Delhi	2	3	1	-	-	-
RRL, Bhubaneswar	3.	7	17	-	-	-
RRL, Hyderabad	3	4	5	-	1	-
RRL, Jorhat	3	1	3	-	-	-
RRL, Trivandrum	6	1	1	-	-	-
	119	66	144	11	2	1

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
FINANCIAL DATA' (Rs. in lakh)

Actual Expenditure for 1988-89

S.No.	Particulars	N. plan	Plan	Total	Internal & other sources	Grand Total
1.	Central Administration i. Pay & Allowances. Contingencies Maintenance	428.38	0.00	428.38	0.00	428.38
	ii. Headquarters Technical Activities	36.99	55.00	91.99	0.00	91.99
	iii. Misc. Pension, Advances etc.	1555.79	0.00	1555.79	0.00	1555.79
	Total C.A.	2021.16	55.00	2076.16	0.00	2076.16
2.	Laboratories	8414.76	6308.61	14723.37	1200.63	15924:00
3.	Scientists' Pool	285.00	0.00	285.00	4.09	289.09
4.	Research Scheme Scholarships and Fellowships	950.00	615.00	1565.00	46.74	1611.74
5.	Industrial Research Associations	55.00	0.00	55.00	0.00	55.00
6.	Pilot Plants	100.00	0.00	100.00	7.36	107.36
7.	Residential Buildings	174.08	695.39	869.47	0.00	869.47
	Grand Total	12000.00	7674.00	196 74.00	1258.82	20932.82